Physiology for Boys and Girls

HOW TO KEEP WELL

A Text-Book of Health

FOR USE IN THE COMMON SCHOOLS, WITH SPECIAL REFERENCE TO THE EFFECTS OF ALCOHOLIC DRINKS AND NARCOTICS UPON THE HUMAN SYSTEM

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ADAPTED TO THE PUBLIC SCHOOLS OF MARYLAND

BY

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PREFACE

TO THE MARYLAND EDITION.

At the request of the publishers, I have attempted to revise Dr. Blaisdell's "How to Keep Well," so as to adapt it to the intermediate grades of the Maryland schools. It is full of useful information and practical suggestions about the ordinary matters of every-day health, so simply told that even the young must understand. The book is so well written in this respect, that very few changes were necessary in the text; here and there a difficult word has been omitted and a simpler one substituted.

The most important alterations from the original are the notes by eminent Maryland physicians, and the chapter on "Malaria," by Jackson Piper, M.D., president of the State Board of Health.

I have also arranged questions at the bottom of each page, instead of having review questions after the chapters, as in the original book. These questions are intended more for the teacher than for the pupil. They are the sign-boards, always within sight, and are intended to direct the attention to the most important points in any lesson.

The book may be used as a supplementary reader, and the subject-matter impressed on the minds of the pupils by familiar talks, frequent reviews, and blackboard, or chart, illustrations.

THOMAS C. BRUFF.

AUGUST, 1886.

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HOW TO KEEP WELL.

CHAPTER I.

INTRODUCTION.

1. **What the Book is about.** — When we get used to any common event, as, for example, to seeing a boy or girl moving, talking, and breathing, we forget to wonder at it, simply because it is so common a sight. But, when one does think about it, how very wonderful it is to be alive! One begins to ask, How do we manage to move our bodies? When one has hurt his foot, how does his head know that he has done so? Why do we breathe and eat? How do we think? and how do we speak?

All these things this little book will try to explain to you. There will not be room to tell you about all the wonders of our bodies, but you will be able to learn the beginning of the story. There is very much more to learn. When you have learned all that is told you here, you will feel so much inter-

Questions. — On thinking about our bodies, what questions should we naturally begin to ask? What is this little book intended to explain?

ested, we hope, that you will wish to learn more. The study of our bodies will not only make us acquainted with many wonderful things, but will also tell us how to get and how to keep good health. Therefore let us do our best to learn as much as possible about our bodies, and how we live.

2. **Our Bodily Life.** — We need not be told that our bodies are made of flesh and bone, whose substance we see and handle every day of our lives. Even a child knows that certain parts of his body, as the walls of his chest, and his heart that he feels beating within it, are always moving of themselves. We can move of our own free will from one place to another. The wind may rustle the leaves, and a breeze may sway a strong oak; but the leaves and the oak have no power to move themselves. We need not wait, like the trees of the forest, for the wind to blow us to and fro, or, like the pebbles by the roadside, for some one to stir us. Like the horse, the dog, the bird, or any other animal that has life, we can move from place to place.

Again: every child cannot but notice that he is always warm. Even in the coldest day of midwinter, let the stones and trees be as cold as the winter wind, our bodies, except perhaps the tips of

Questions. — Tell in your own words some of the good to be gained by its study. How may a child get some idea that his body moves? Tell what is said of the warmth of the body.

the fingers and toes, are always warm. The horse, the dog, and even the birds and the bees, are warm: all animals, in fact, are more or less warm as long as they are alive.

3. **The Body compared to a Steam-Engine.** — Our bodies are in some ways very much like a steam-engine. The bones and the muscles resemble the machinery of the engine, while the motive-power is produced by the food we eat. We put fuel into the furnace. The water in the boiler is heated, and expands into steam. Then the piston begins to work to and fro: this moves the wheels, joints, and levers, and so the whole engine is set in motion by the fuel in the furnace.

Now, just the same thing occurs in our bodies. We take food, and that food passes into the stomach. By reason of that food we are kept warm, muscular force is developed, and the levers and joints within us are set working, as we see in the steam-engine. There is, however, this important difference between the two: The engine is all the time wearing itself out; it works badly now and then, so it must be stopped, taken to pieces, and repaired. Our bodies, too, are all the time wearing out; but they are continually repairing themselves, even while in constant use. Hence we take food,

Questions. — In what way does the body resemble a steam-engine? What important difference is there between the two?

not only to warm us, but also to build up and repair our bodies.

4. **The Body and its Nervous System.** — Every child knows that when he cuts his finger with a knife, touches a hot stove, or has eaten unwholesome food, as an unripe apple, pain is produced. Silvery-white cords, called nerves, start from the brain, and are spread all over the body; and, when any thing wrong happens, these little nerves, like telegraph-wires, carry special despatches to the central station (that is, to the brain), and thus the feeling of pain is there made known. In this way every part of our bodies is watched over and protected. If it were not so, we should be continually hurting ourselves, and not know it. For example, a drunken man, whose nerves had been deadened by alcoholic liquors, once went to sleep by a camp-fire; and, when he woke up, his feet were so horribly burned that they had to be cut off. If his brain and nerves had not been benumbed, he would have felt the alarm of pain, and saved himself.

If we exert our will, or "make up our mind" as we call it, to write with a pen, to pick a flower, or to call the name of some friend, we can do it. The mind, or brain, wills to do this or that thing. It

Questions. — What happens when a child cuts his finger with a knife, touches a hot stove, or eats unripe fruit? Explain in what way we are kept informed of injuries done to any part of our bodies.

sends out its order by the tiny white nerves, and the muscles are put in motion to do whatever the brain has willed them to do. This mind, which feels and thinks, but which we cannot see, forms the real part of our being. It is the power to feel, to know, to reason, and to will, that makes us what we are. When we stop to think about it, how wonderful it is! Indeed, the more we think of it, the more we shall realize the fact that the all-wise Creator, in his goodness and wisdom, has given us bodies which, in the words of the Psalmist, are "fearfully and wonderfully made."

5. **Some Hard Words explained.** — Before we can reach the more interesting part of our study, we have to do something like cracking the shell of a nut to get at its kernel: we shall have to learn the meaning of a few hard words which must be used in talking about this subject, and will be often used in this book. Before we can tell how plants and animals *live*, we must know what plants and animals *are*. A watchmaker could not describe the working of a watch unless he first carefully learned the various parts. So it is with the study of our bodies: we must learn their structure before we can understand the manner in which they act and move, or, in short, how they live. The science which tells

Questions. — What is it that makes us what we are? Why is it necessary to know the meaning of certain words at the beginning of this study?

us about the structure, form, and position of the different parts of our bodies, is called **Anatomy.** It tells us what these parts are, where they are, and how they look. The science which explains the uses of the different parts of the body is called **Physiology.**

Now, after we have learned something about the structure and the uses of different parts of the body, we ought to learn how to take care of them and to keep them in health. We do this by the study of **Hygiene,** or the science which tells us about health. Take the skin for an illustration. If we learn what it is, how it looks, its various parts, this would be its Anatomy. Now, if we learn for what special purpose it is made, just what its different parts do, and how they do it, this would be its Physiology. Finally, if we learn how each part is kept in good order, what will injure its health, and what will do it good, this would be its Hygiene.

A **tissue** is the simplest form in which any part of the body can exist. We thus speak of the skin as a tissue, bony tissue, muscular tissue, fatty tissue, and so on. Each tissue has certain features about it which mark it wherever in the body it is found. They may be compared to the brick, stone, iron, mortar, glass, and other materials which, properly arranged, make up a house.

Questions. — What is meant by anatomy? physiology? hygiene? a tissue? Illustrate. What is an organ?

Any part of the body which does a special work is called an **organ.** It is simply several tissues working together as a whole, and specially fitted to do a certain thing: thus the eye is the organ of sight, the nose of smell, the ear of hearing, the stomach of digestion, and so on. When there is a series of organs scattered through the body, similar in structure, and all doing the same work, we call it a "system:" thus we speak of the arterial system, the nervous system, and so on. The special work which an organ has to do is said to be the **function,** or use, of that organ: thus it is the function of the eye to see, and of the stomach to digest food. The word "glands" will be often used. **Glands** are factories of all kinds of shapes and sizes, and located in many different places in the body, whose business it is to make out of the blood something to be used again, or to rid the blood of something to be cast out of the body. Thus the salivary glands make saliva, or spittle, and the sweat glands make sweat. The liver, which weighs about five pounds, is a single gland, and secretes bile; while the glands in the intestines cannot be seen by the naked eye.

6. General Parts of the Body. — If we look at our body, we see that it is made up of a middle,

Questions. — What is meant by the functions of an organ? Illustrate. What are the glands? Name some, and give their use. Name the general parts of the body.

barrel-shaped part, which is called the **trunk.** Above this is placed a kind of round ball, which is called the **head**; while two pairs of branches, called the **limbs,** are attached to the upper and lower corners of the trunk. Again, we see that the whole body has an outer covering, the *skin.* Underneath the skin lie long bundles of red flesh, called *muscles.* These are mostly fastened at each end to the hard parts or bones. The bones make up the framework or **skeleton** of our bodies. The limbs are solid; but the head is hollow, and holds an organ called the *brain,* the centre of the nervous system. A cheesy-like substance, called the *spinal cord,* passes from the brain down the middle of the backbone, and sends its thread-like branches, called *nerves,* all over the body.

It is through the nervous system that we are able to think or feel, or, in fact, to know any thing. Most of the organs of the body are in the **trunk.** Suppose we take away the skin, the muscles, and the ribs, which hide the inside of the body from us, and what shall we see? (Fig. 1.) Perhaps you have wondered how your heart, your lungs, and all the other parts which you know you have in your body, are arranged. You may be able to see, very likely, the

Questions. — Locate the skin and muscles. Where and what is the brain? Where and of what use is the spinal cord? Where are most of the organs of the body located?

body of some dead animal, such as a rabbit or a pig, cut open. If you can, this will give you a better idea of your own self than any picture can do. The inside of our body is very nearly like that of one of

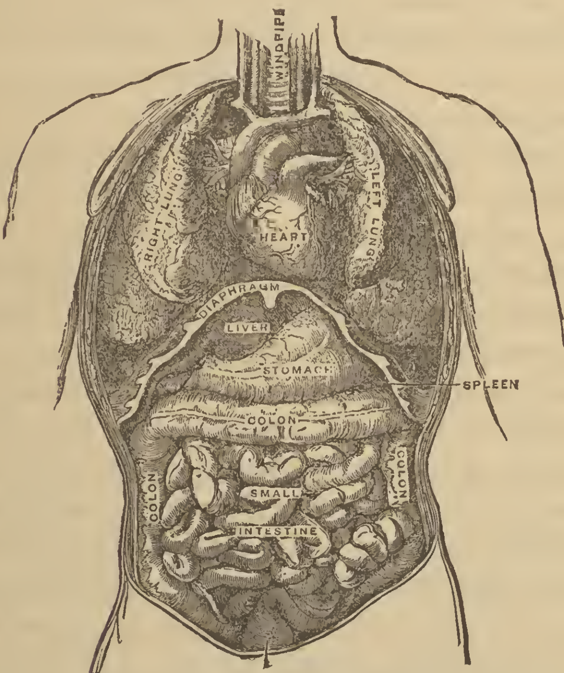

FIG. 1. Contents of the Chest and Abdomen.

the lower animals. They have the same organs we have, doing the same work. If you can see the inside of any animal, you will be sure to notice how closely and carefully the organs are packed in the **trunk.** There is no space for any one of them to

move about; if one is ever pushed from its place, it must crowd upon and hurt another.

One of the first things you will notice in Fig. 1 is a partition, in the form of an arch, separating the top part of the trunk from the bottom. This is called the *diaphragm.* It makes the **trunk** a two-story house, — the abdomen down-stairs, and the heart and lungs in the chamber.

Above the diaphragm — that is, in the chamber, or **chest** — are the heart and the two lungs. Below the diaphragm — that is, down-stairs, or in the **abdomen** — are the stomach, the liver, the pancreas, the spleen, the intestines, and the kidneys. These last-named organs lie behind the intestines, and you cannot see them in the picture. You can see neither the whole of the stomach nor its exact shape. The same is true of the liver and spleen and the pancreas; for these are behind the stomach, next to the backbone. But you can see the position in which most of them lie beside each other, and you should study the picture (Fig. 1) till you can remember their arrangement very well.

7. **Why the Care of our Health is a Duty.** — We ought to keep ourselves in good health as far as we are able, that we may do well the duties of life, and

Questions. — What is the diaphragm, and where is it located? Name the organs located in the chamber above the diaphragm. Name those in the chamber below it.

be useful to others instead of being a burden to them. Few people can be happy or very useful if they are not well. Every one has some work to do in the world: no one is made to be idle. Some have to work with their hands, others with their heads; but no kind of work can be done well unless the body and the mind are healthy.[1]

To keep ourselves alive, we must have two things, — food and air. But to keep ourselves healthy, the food must be of the right sort, and the air must be pure; we must be cleanly and temperate; we must have plenty of exercise in the daytime, and plenty of sleep at night. If we know the use of the different parts of our bodies, as the lungs, the heart, and the stomach, we shall understand better how to keep them in good order; just as a man can take better care of his watch if he learns the use of the different wheels and springs. We cannot prevent all sickness and disease, but a great deal may be prevented when people learn to take care of their health.

Questions. — Why is it a duty to take care of our health? What does Dr. McSherry say in regard to the bad effects of neglecting this duty?

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[1] Perverted health is a great factor in personal, domestic, and social unhappiness. Riches and fame, and power and glory, and learning, are all *bagatelle* as compared with health. Now, as health is the best gift that man can have, so far as the mere mortal career is concerned, it follows that its conservation merits perpetual and universal attention. — RICHARD MCSHERRY, M.D.

CHAPTER II.

THE BONY FRAMEWORK.

8. The Framework of the Body. — The bones are the framework of the body. They are to the body what whalebones are to an umbrella, what timbers are to a house, or ribs to a vessel. They are the framework of the engine, while the chest and abdomen are the boiler and tender; our food being the coal. The brain is like the engineer, who directs all. When he moves a lever, the steam rushes into the machinery, and puts it in motion. When we wish to move, a message goes from the brain to the muscles along the nerves, and the muscles move the bones.

But bones are something more than a framework They serve many useful purposes. They protect the soft parts which lie beneath them. Thus the bones of the skull shut up the soft and delicate brain in a box of bone, and the ribs protect the heart and lungs in a barrel-shaped cage of bone. Little cups and tunnels are hewn out of hard bone to shield

Questions. — To what may the bones be compared? What useful purposes do they serve?

vital organs. Grooves and canals are made in solid bone to shelter tiny blood-vessels and delicate nerves. Even the outside of bones is fitted with little knobs, grooves, and sharp edges, to which muscles and cords are fastened. In short, the bones are, as it were, a foundation upon which our bodies are securely built.

How many bones do you think we have? Let me tell you. There are in all about two hundred separate bones of various sizes and shapes. Taken together they make the **skeleton.** We are all familiar with the picture of the human skeleton (Fig. 7).

9. **How Bone is made up.** — Bones are very hard and strong. On examining a ham or mutton bone, we would hardly believe there is any soft matter in it. In reality, every bone is made up, both of a soft, jelly-like substance, called gelatine or animal matter, and a hard substance, earthy matter, made largely of the mineral known as lime. Let us show this by two simple experiments. Soak a chicken's leg-bone for three days in a mixture of two ounces of muriatic acid and one pint of water. On taking it out, while the shape of the bone is the same, we find we can easily bend it, like a piece of rubber, or even tie it into a knot. What has taken place? Why, the acid has eaten out the bits of lime, and left only the soft gelatine.

Questions. — About how many bones are there in the human body? What is the skeleton? Explain the general structure of the bones.

Again: put a soup-bone on the hot coals, and let it burn for three hours. Take it out carefully, and examine it. What do you see? The shape of the bone is the same; but it is brittle, and will easily crumble between the fingers. Why so? The heat has burned out the soft gelatine, and left only the bone-earth. In childhood the bones have more animal matter than earthy salts, while in old age they have more lime than gelatine. Hence the bones of children often bend rather than break in the many severe falls they meet with; while the bones of old people, being brittle, often snap like a pipe-stem with very slight injuries.

Bones are elastic. If a skull falls on the floor, it will rebound. The ribs are elastic. The Arab children make excellent bows with the ribs of camels. The power of bone to resist decay is remarkable. The gelatine — enough to make good glue — will last in a bone for hundreds of years.

10. General Structure of Bones. — If we take a long bone, like that from a sheep's leg, or even one end of a soup-bone, and saw it lengthwise, we see that the ends are soft and spongy, while the rest is as hard as a rock (Fig. 2). The bone is hollow inside, and filled with a soft, oily substance, called

Questions. — What two experiments prove that the bones are composed of animal and vegetable matter? Why are the bones of old people more liable to break than those of the young?

marrow. It is this which makes the flavor and richness of soup. Crush one end of a bone, and hold it over a hot fire. The heat will soon melt the marrow, which will sputter and burn like tallow. The marrow is the life of the bone. When people speak of a person wanting in energy, they say, "He has no marrow in his bones." The Bible tells us that the "bones are moistened with marrow." Achilles

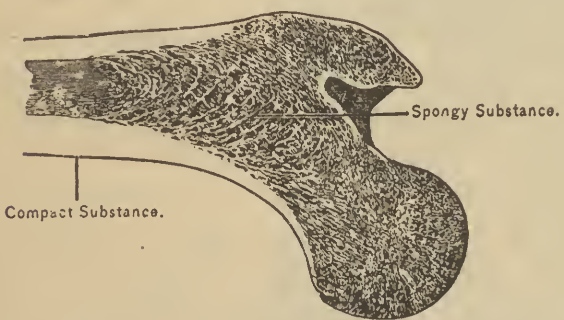

FIG. 2. — End of a Bone sawed open, showing the Spongy and Compact Portions.

was a famous Greek warrior of olden times. His teacher, a fabled giant, it is said, fed his pupil upon the marrow of the lion to make him brave. The bones of some animals, like lobsters, are, as you know, on the outside. All our bones are, of course, inside, and are covered with muscles and fat; and over all is the skin.

Again: while we do not cast off our skeleton for a

Questions. — With what is the inside of the bones filled? Of what use is this substance to the bone?

new one every year, as the lobster does, yet our bones are all the time being changed. They are never the same throughout any single hour of our lives. The bones are supplied with millions of the tiniest holes, through which hair-like blood-vessels wind their way, bringing food for the bone, and carrying away waste matters (Figs. 3 and 4). Thus the blood, "the river of life," oozes its way through every bit of bone as freely as through any other living tissue.

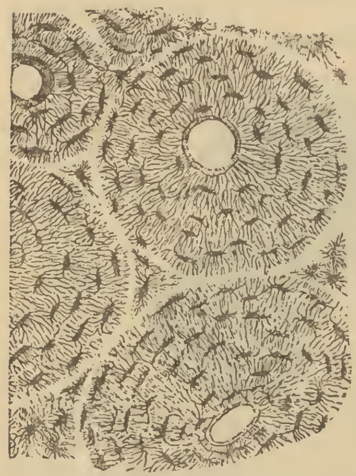

FIG. 3. — Section of Bone as it looks under the Microscope, showing Openings of Canals.

Bones are of many different shapes, according to the uses to which they are put. Some are long and hollow, as the bones of the arm and leg; while others are short, as the bone of the fingers and toes. Some are flat, to cover exposed places, like the knee-pan and shoulder-blades; while others are of various odd shapes, as the bones of the ankle and wrist, and the backbone (Figs. 3 and 4).

Question. — Explain how the bones are kept in a healthy condition.

11. The Head. — The **skeleton,** or bony framework of the house we live in, — a house far more wonderful than any king's palace, since it can walk, and the walls are living, — consists of the bones of the **head,** the **trunk,** and the **limbs.** The bones of the head make a very strong box of bone, commonly called the skull (Fig. 5). When we speak of the head we mean the head and face.

FIG. 4. — Cross Section of Bone, highly magnified; the Canals are left White.

The top part of the head, which is sometimes

FIG. 5. — The Skull.

Questions. — For convenience, into what divisions are the bones of the body divided? Tell what you can about the bones of the head.

called the brain-case, is a kind of bony shell which holds the brain. It is made up of several bones tightly locked together by seams something like the dovetailing used by a carpenter (Fig. 6). Put your hand on the head of a babe just above the forehead, and you will find a soft space, called a "little fountain." Why is this? Simply because, in very young children, these bones, which grow on their edges, do not yet meet, and the throbbing of the brain is easily seen and felt through the thin scalp. Now, as the bones of a child's head are thus dovetailed into each other, they yield a little, and do not break even if he tumbles and bumps his head every day.

FIG. 6. — The Dovetailed Joints, or Sutures, on Top of the Skull.

All the bones of the head, except the lower jaw, — the only movable bone of the head, — are firmly locked together by these dovetailed stitches, or sutures as they are called. The dome shape of the skull makes it stronger. If you have ever tried the

Questions. — How are these bones fastened together? What gives them their strength?

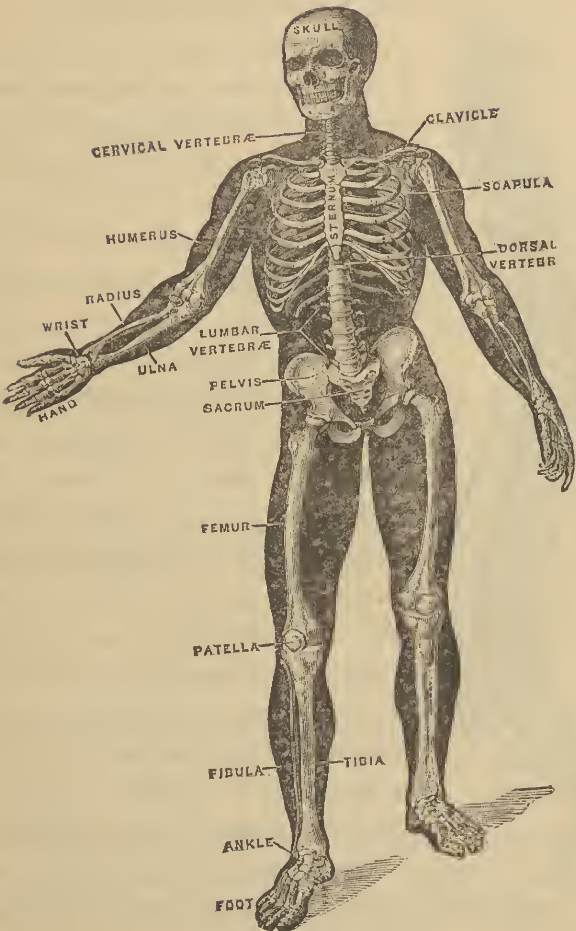

FIG. 7. — Skeleton of Man.

strength of an egg-shell, you can understand what hard blows the head will bear.

Fig. 8. — The Backbone.

Let us see what this box of bone, the cupola of our bodily house, holds: our eyes, with which we see; our ears, with which we hear; our mouths, into which we put our food; the nose, with which we smell; and then our brain. Indeed, it is a very precious box, we think.

12. The Trunk. — The **trunk** is the central part of the body. Let us describe its bones, as those of the **backbone,** the **ribs,** and the **hips.** The **backbone,** or spine, the main pillar of the building, is a tapering pile of separate bones put one on top of the other. The bottom of each fits exactly into the top of the next. Between the bones are little cushions of gristle. They help break the force of any shock or injury to the spine, just as the springs of a carriage lessen the jolting. They also save any wear or tear of one bone on another,

Questions. — Name all the organs contained within the skull. What is the trunk? Where is the backbone, or spine? What is placed between these bones, and what useful purposes does it serve?

and yet allow of their moving pretty freely (Fig. 8). You would hardly believe it, but people who stand or walk much are really a little shorter at night than they were in the morning. A day's work presses together these magic springs; while a night's rest allows them to expand, so that by the next morning we are as tall as ever. The story is told of a young man, who, being just the exact height for military service, walked all night before going up for examination. He gained his point, for he was no longer tall enough to serve as a soldier.

Each bone of the spine has a large hole through it. Imagine a number of spools piled end on end, with the holes exactly over each other. Then there would be, of course, one long hole through the whole string of spools. This is somewhat the way the bones of the spine are arranged. From each bone of the spine project thorns of bone, to which are fastened muscles which keep the back up, and lift the head and shoulders. We can feel these bony ridges by running the fingers up and down the middle of the back. The next time you see a fish on the dinner-table, ask to be shown the large middle bone. It is the fish's backbone; and it will give you an idea of your own, for it is built on the same plan.

Questions. — Why is the body shorter at night than it was in the morning? How is the spine arranged? Illustrate.

The spine is really one of the most curious things in nature, so firm and yet so elastic, giving the body its graceful form. Think of the great weight which a man can carry on his head with ease and safety. Circus-performers will bend their heads back until they almost touch their feet, thus bringing this curious pile of bones nearly into the shape of a bow.

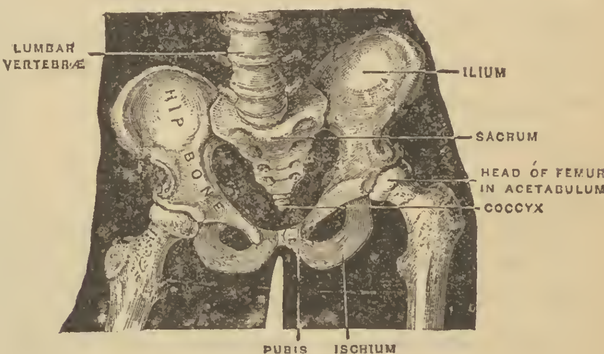

FIG. 9. — The Hip-Bones.

The **ribs,** twelve on each side, spring from the backbone, and pass round the chest somewhat like the hoops of a barrel, and are united in front to the breast-bone. The upper ribs are fixed: the lower ones bend and move when we breathe. If we press our hands on our sides, and take a deep breath, we can feel how much the ribs move.

Every child knows how to rest his hands on the

Questions. — Describe the location of the ribs. How many on each side? Locate and describe the hip-bones.

hips, the two large, strong bones which make up the lower part of the trunk (Fig. 9), — the sills of the house, as it were. Each of these bones has a deep, cup-shaped cavity on its side, about as large as a toy china teacup, into which the round head of the thigh-bone fits.

13. **The Shoulder and Arm.** — The shoulder consists of the **collar-bone** and the **shoulder-blade,** the braces of the upper part of the body, one before and one behind. We can easily feel the collar-bone running across the top of the chest, like a slender cross-beam, over and above the first rib. It is fastened at one end to the shoulder-blade and at the other to the breast-bone. The shoulder-blade is easily found. Put your hand to your shoulder where officers wear their epaulets, and move your arm up and down. You will feel a bone which seems to dance with every movement of the arm. This is the shoulder-blade (Fig. 10). It has a cup-like cavity, into which the round head of the arm-bone fits, and in which it moves with the greatest ease. The main bone of the **arm** extends to the elbow, where it meets the two bones of the **fore-arm.**

FIG. 10. — Back of Right Shoulder-Blade.

Questions. — Describe the collar-bone. The shoulder-blade. The bones of the arm. What are they?

Now comes the **wrist**, made up of eight little bones wedged together like the stones of a pavement, only not quite so firmly. From the wrist come the bones of the **hand**, ending with the thumb and fingers (Fig. 11). The hand enables us to take hold of any thing, as a cane, or to strike a blow when the fist is doubled up. The bones of the hand, wrist, and

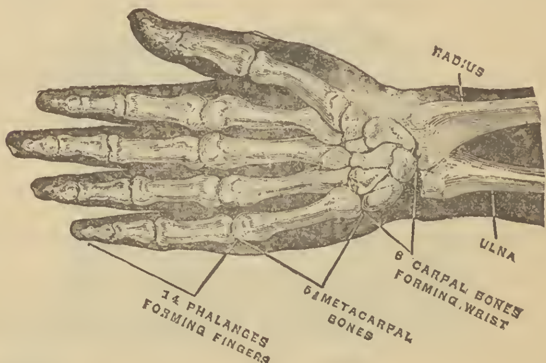

Fig. 11. — Palm of Right Hand.

fingers are held in place by strong but flexible bands and cords. This gives, as you may imagine, a great variety to their motions; so that the hand can do almost any thing that we wish it to do, from grasping heavy hammers, to holding a pen, and threading the finest needle.

It is very curious, that, although the hand of the monkey and the orang-outang seems very much like

Questions. — Describe the wrist and the hand. How are these bones all held in place?

yours and mine, yet his thumb is on a line with his fingers, and bends in the same direction they do; while our thumbs are opposite our fingers, giving us a wonderful advantage in grasping and holding objects. Man is the only animal that has his thumb opposed to his fingers.

How wonderful it is that the deaf and dumb talk with their hands, and the blind read with their fingers! Even the most common things that we do with our hands every day are really wonderful. In brief, the arm and hand, with their fifty different muscles and thirty bones, supplied with cords, nerves, blood-vessels, covered with skin, and furnished with nails, make a wonderful set of machinery.

14. **The Legs.** — How useful are the **legs** to every other part of the body! Without bones in our legs we could not stand or walk. They are made so strong that they can support the weight of the body, and so light that they are capable of a great variety of movement. The upper bone of the leg, the **thigh-bone**, the longest and strongest bone in the body, reaches down to the knee. It is so large and so heavy, that, in handling it, one might imagine it to be a club; in fact, the warriors of savage tribes sometimes wear the thigh-bones of slain enemies, as a weapon, at their waists. At the knee-joint the

Questions. — What is the difference between our thumbs and those of other animals? Describe the thigh-bone.

thigh-bone meets the bones of the lower leg, to which it is united by stout cords and bands. A flat, three-sided bone, called the **knee-pan,** fits over the knee-joint in front. You know, if we fall in running, we are apt to strike on the knee. This little heart-shaped bone keeps the joint from getting hurt.

FIG. 12. — Bones of Foot and Ankle.

There are two bones in the leg below the knee, — the **shin-bone** and the **splint-bone,** connected with the foot at the ankle-joint. The **ankle** contains seven queer-shaped bones, something like those of the wrist, but rather larger. They are bound firmly

Questions. — Describe the knee-pan. Name the two bones in the leg below the knee. What can you say of the ankle?

together, and are strong enough to bear the weight of the body (Fig. 12).

The **foot** forms an arch known as the instep, not unlike the arch of a bridge, with the heel at the back and the toes in front. On this arch the body rests. It is not only very strong, but, owing to the toes being formed by several bones, the whole foot is elastic, and forms a spring by which the body is thrown forward without the other bones being shaken or jarred against each other.

In animals which leap after their prey with a jump or spring, this elastic character is increased; and they are provided with pads under each joint, which serve to break the shock they would otherwise receive. You know how quietly and nimbly a cat runs. Now, if you look at her paws when she has "gloves on," you will see that this is owing to the little black cushions under them.

We have, as every one knows, ten toes, — five on each foot. The toes help us spring in walking. Gristly bands and cords bind the twenty-six little bones of the foot firmly together, and yet allow of many different motions. It is wonderful what habit and necessity will make the foot do. We who cramp our feet in tight boots can hardly believe it when we hear of persons carving, writing, and even painting, with the toes. A few years ago a French artist

Question. — What can you say of the foot?

used to paint with his toes pictures worthy of a place in the French Exhibition. Some savage tribes in Australia, it is said, walk into shallow streams, and catch fish with their toes. Travellers tell us that certain African tribes steal with their toes as easily as with their fingers. Chinese mechanics will pick up tools with their toes, and work with them while using other tools with their hands. The Arabs use their fingers and toes at the same time in braiding ropes.

15. **How Bones are joined together.**—The place where one or more bones meet and move upon each other is called a **joint.** Get a knuckle of ham or mutton at the market, open the joint by cutting into it, and study what you see. Our own joints are made exactly after the same general plan. The ends of the bones, shaped, as you will see, according to the needs of each joint, are moist, and tipped with a smooth, glistening layer of gristle. The next time you have a piece of roast veal on the table, examine it carefully, and you will see at the end a white substance, which crackles under your teeth: this is gristle.

Joints are bathed with a sticky fluid something like the white of an egg: the common name for it is joint-oil. It allows the rubbing surfaces to move

Questions.—What is a joint? What is placed between the joints of the bones, and for what wise purpose?

smoothly one on another, thus saving much wear and tear. Think of a man who could build a machine which would last "threescore years and ten" or more, and keep its own joints oiled all the time!

Some of our joints are real hinges. At the elbow there is a hinge-joint (Fig. 13). All the time a carpenter hammers, he uses the hinge-joint at his elbow. All our fingers and toes have hinge-joints. The most curious joints are called ball-and-socket joints. The head of the arm-bone, as you know, fits into a cup in the shoulder-blade. When we move our arms round and round at the shoulders, we use this joint. A boy uses this joint all the time he turns a grindstone, or swings a bat in playing base-ball.

FIG. 13. — The Right Shoulder-Joint.

The round head of the thigh-bone, as you already know, fits into the cup-like socket of the hip-bone, thus giving the legs great freedom of motion (Fig. 14). All these joints are liable to be put out of their place. This often happens to the shoulder-

Questions. — Mention the different kinds of joints. What may often happen to any of the joints? With which is it most frequent?

joint, and occasionally to the hip-joint. Those who play ball, often put their finger-joints out of place. We should be careful not to play at too violent and rough games, by which we may not only put the joints out of place, but may also break the bones and sprain the cords. Many children have the habit

Fig. 14. — The Right Hip-Joint.

of pulling the finger-joints to make them "crack." This is a foolish custom: it disfigures the hand by enlarging the knuckles, and, besides, may cause permanent injury.

16. How Bones are tied to Each Other. — If we pick up two bones that have lain for years, perhaps, bleaching in the sun and rain, we find that

Questions. — Why should we be careful in our play? In what foolish custom do children, and sometimes grown persons, indulge?

the ends are smooth, and may fit exactly into each other. Put the ends together, and they will not stay a moment unless tied together by strings or something of the kind. How, then, are the joints held in their places? How are bones kept together in the living person? Simply by strong straps. Some of them are as narrow as a piece of tape; others, as at the side of the knee or at the shoulder, are quite wide. Some cross each other, as at the knee-joint; while others shut in a joint, like a bag or sack, thus saving it from being easily slipped out of place. You will find out some day that it takes some skill to carve a turkey or a fowl, because we have to cut round these cords to disjoint it neatly, and serve it out in pieces for the plate. (Fig. 15.)

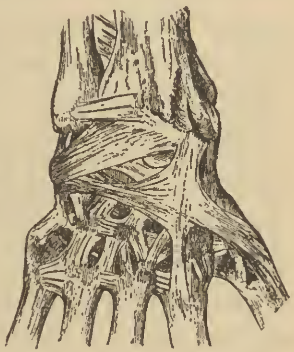

Fig. 15. — Showing how the Wrist-Bones are tied together.

17. **The Health of the Bones.** — The bones of an infant will easily bend, and even grow out of place, because they are soft and gristly. Stories are told of Indian tribes, the Flatheads, who used to tie small pieces of board, with bands and bandages, firmly on the soft and tender heads of their babies,

Question. — How are the bones of the body tied together?

to flatten them, thinking that a flattened skull of this shape is beautiful. Bones, especially in children, are readily changed by long-continued pressure or strain. You may have heard of the distorted feet of Chinese women. These people think it is low-bred for women to be useful, and have natural feet: so they bind the baby's feet, if it is a girl, with strong bands, to prevent them growing. When these poor children become women, they are scarcely able to move about.

Did you ever think how hurtful and silly is the fashion of wearing tight and high-heeled boots and shoes? Why so? Because high heels throw the weight of the body forward, and force the foot down on the toes. This tends not only to crowd the toes out of shape, causing tender feet, corns, bunions, in-growing nails, and swollen joints, but makes the natural gait stiff and ungainly.

Knowing the practical importance of having comfortable feet, Frederick the Great kept a servant whose foot was exactly his size, and made him wear his new shoes till he himself could wear them with comfort; and, poor fellow, he sometimes wore them too long, and got kicked by his royal master for his pains. The Duke of Wellington, being asked once as to the most essential article of a soldier's clothing,

Question. — Why is it hurtful to wear tight and high-heeled boots or shoes?

replied, "A good pair of shoes." — "What next?" — "A spare pair of shoes." And even thirdly, "A spare pair of soles."

Children should not be allowed to walk too early, before their legs are strong enough to bear the weight of the body. The soft bones may bend, and cause "bow-legs," so commonly seen on the street. Children should not get into the habit of taking unlikely positions, such as sliding down into the seat, or sitting on the foot. Bending over too much while reading, writing, sewing, or otherwise at work, is apt to cause round shoulders.

At school the desks should not be too low, thus causing a forward stoop; or too high, thereby throwing one shoulder up too much, and giving a twist to the spine. If the seats are too high, the feet have no support, and injury to the thigh may result; if too low, there is undue strain on the shoulder and backbone. Round shoulders and curvature of the spine may result from long-continued positions of this kind.

Collateral Reading. — Hooker's *Child's Book of Nature*, Part II.; McSherry's *Health, and How to Promote It.*

Questions. — What is likely to occur if children are allowed to walk too early? What may cause round shoulders and curvature of the spine?

CHAPTER III.

THE MUSCLES.

18. **Our Muscles.** — We move and walk from place to place by means of our **muscles.** Our limbs are moved by the muscles. Muscles move not only the limbs, but the skin. Watch the horse, and see him shake his hide to get rid of the biting flies. Our bones, our fingers and toes, our mouths, our eye-lids, — all are moved by muscles. In short, all motion in our bodies is dependent upon them.

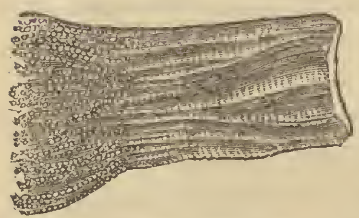

FIG. — 16. A Muscular Bundle teased out to show its Fibres.

Muscle is simply lean meat or flesh. When we eat beefsteak or lean mutton for dinner, we are eating muscle. When

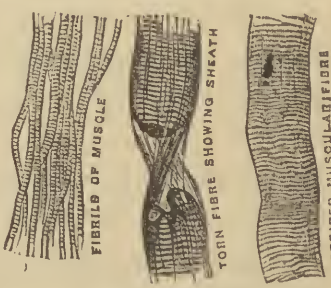

FIG 17. — Portions of Muscular Fibre, highly magnified.

Question. — Of what use are the muscles?

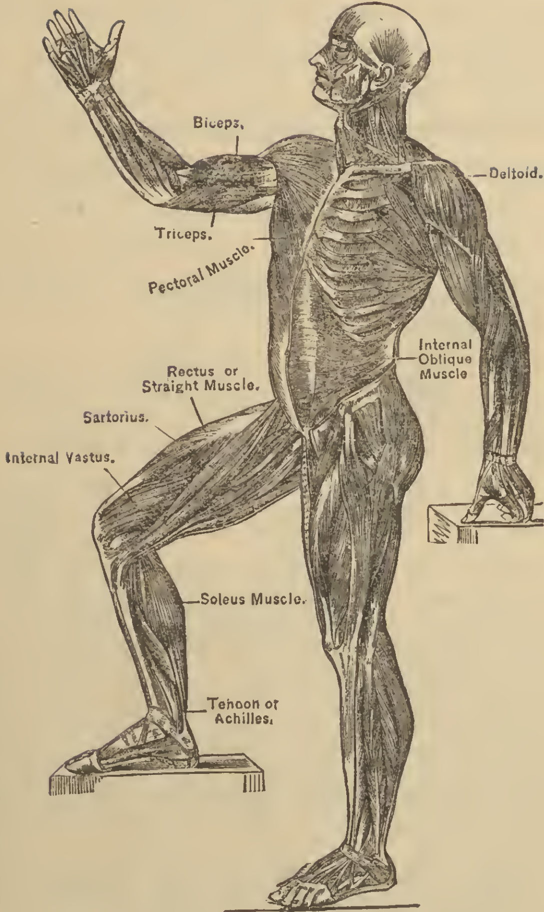

FIG. 18. — Principal Muscles of the Front of the Body.

corned beef is boiled very tender, so it falls apart, we can easily divide it into strings: these strings are muscular fibres (Figs. 16 and 17). See how they are glued together, into bundles of various shapes, by a very thin web not unlike the thinnest of thin tissue-paper. Each bundle is called a muscle. We may compare a muscle to a handful of tiny skeins of silk packed into bundles, and dividing again and again until they are a thousand times finer than the finest hair on our heads.

Muscles are of all sizes and shapes. Some are large, others very small; some are shaped like fans, others like quill pens; many are broad and flat in the middle, and taper down at each end. In brief, the shape of muscles varies according to the place where they are put and the work they have to do. Sometimes we can see the shape of the muscles through the skin, especially in the arm and shoulder of a man who does hard work. See the brawny arm of the blacksmith as he works at his forge. Look at those large muscles, strong as iron bands, that swell out as he brings his hammer down on his anvil.

19. How the Muscles do their Work. — Muscles have a peculiar power of their own, which no other kind of tissue in the body has. This is the

Questions. — Describe the muscles. What may be said of their sizes and shapes?

power to become shorter and thicker. We see something like muscular action in a piece of india-rubber. If we take a piece of this, and pull it out longer, we see that it becomes thinner; and when we let it go, it snaps back, and once more becomes short and thick. This is very much like the action of our muscles; but muscular tissues do this by

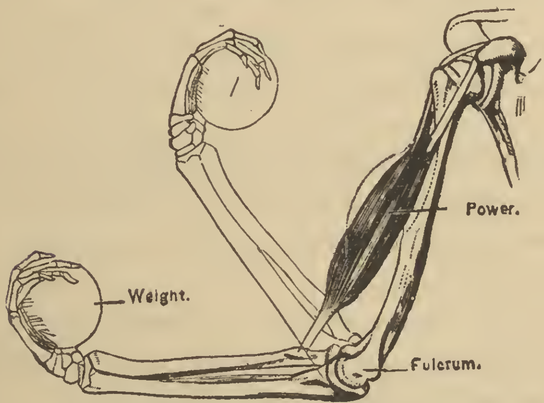

FIG. 19. — Action of a Muscle illustrated by the Biceps.

their own peculiar power, without being pulled by some one else, as a piece of india-rubber must be.

Now, let us see how this power in our muscles enables us to move. Let us notice what happens when we bend the arm, as boys do "to try their muscle." You will understand that all similar actions — such as closing the hand, opening the mouth, lifting the leg, and so on — are done practically in

Question. — In what ways may a muscle alter its shape?

the same way. Stretch out your right arm, and grasp it with your left hand above the elbow, half-way to the shoulder (Fig. 19). Now bend your right arm briskly up and down, and feel the big muscle on the front of the arm swell and harden as you hold your hand upon it. What has happened? Let me tell you. When we wish to draw up our hand toward our shoulder, the brain sends a message to the muscle; and the muscle at once becomes thicker and shorter, and pulls up the fore-arm towards the shoulder. Watch the bare arm of a strong man while he pulls up his hand to his shoulder, and you will see the muscle swell up as it becomes thicker and shorter. In this way almost all our movements are made.

This is muscular action; and this growing thicker and shorter, by which the action is done, is called the **contraction** of a muscle. All muscles act in this way by contraction; though, of course, all the muscles are not fastened to bones. Thus the tube by which food passes from the mouth to our stomach is made of rings of muscle. These rings contract, one after another, and so the food is pushed by a worm-like motion into the stomach. So one of the muscles of the mouth is a ring. This enables us to pucker our lips.

Questions. — Explain how this power in the muscles enables us to move. What is meant by the contraction of a muscle?

20. Some Muscles not under the Control of our Will. — There are some muscles in our bodies, however, not under the control of our will. We do not mean to say that they are not controlled by the nervous system, but simply that they are not directed by our brain at first hand. In brief, these muscles do not need to have a message come from the brain telling them what to do. Let us study this a little. The stomach, for instance, which digests our food, is made of this muscular tissue which our will does not control. As soon as we swallow a mouthful of food, and it passes into the stomach, the nerves feel that it is there, and cause the muscles to begin to act in the proper manner for digesting it. Thus food is digested whether we are willing or not.

The heart, which pumps the blood is another of these muscles which serve to show us the reason why they act without our will having to order them. We know that the heart is always beating. If we lay our hand on our left side, there it is, *thud*, *thud*, never stopping so long as we live. If it stops, we shall die. Now, if we had to will every beat of our heart, how dreadful it would be! We should not be able to think about any thing else. Years ago a man lived in Ireland who could, by an effort of his

Questions. — Name the muscles that are not under the direct control of our will. Illustrate by the stomach and heart.

will, cause his heart to stop beating for a few moments. He at last lost his life in the act.

Remember, then, that many important organs, made of muscular tissue, but intended always to do some special work, are under the management of nerves, but not of that part of the brain through which our will acts; while other muscles which have to do different things at different times, such as those of our hands, our feet, our eyes, and our lips, are under the control of our will, and do what we bid them.

21. The Tendons. — Some of the muscles are fastened directly to the bones, and grow, as it were, into them. As a general thing, however, muscles are not themselves fastened to bones, but taper into white, tough cords, called **tendons.** Put your hand in the hollow of the knee, and you will feel something like cords which you would almost mistake for bones when they stiffen. If we put our fingers on the front part of our wrist, and then work our hands and fingers, we feel some cords just beneath the skin (Fig. 20). These are tendons, the little ropes with which the muscles in the fore-arm pull the hand and fingers.

Again: if we bend our fingers to and fro, we can

Questions. — What kind of work are these muscles required to do? What kind of work are those required to do that are under the direct control of the will? What are tendons?

see the tendons move on the back of the hand. Children at Thanksgiving-time often amuse themselves by pulling the white cord in the leg of the turkey, and seeing its toes move. Tendons are most numerous about the joints, especially the larger

FIG. 20. — Showing the Muscles and Tendons of the Hand.

ones, like the knee and elbow. They save a great deal of space, and allow great freedom of movement where muscles large enough to do the work would be bulky and clumsy. What a large and clumsy foot we should have if all the muscles which are needed to pull the toes were in the foot!

Questions. — Where are the tendons to be found? Explain their uses.

The longest and strongest tendon in the body is just back of the ankle (Fig. 21). It is called the tendon of Achilles, after the Greek hero of that name. According to one story, Achilles received his death-wound in the heel, no other part of his body being liable to injury. A horse is said to be "hamstrung," and so rendered useless, when this tendon is cut.

FIG. 21. — Bones of Leg and Foot, and Muscles of Calf.

22. Why we need Exercise. — Every part of our bodies ought to be used if we wish to be vigorous and healthy. You know what stout, strong arms a blacksmith has: that is because he uses them so much. Constant use, instead of wearing them out, as it would if they were tools, does them good. It is just the same with other parts. A person who uses his eyes as he ought, has good eyesight, and sees many things another person cannot see. A person who uses his ears as he ought, comes in time to hear many things another person does not hear. We are told that savages,

Questions. — Name and locate the longest and strongest tendon in the whole body. Why do we need plenty of exercise?

who are always looking and listening with all their might, either for enemies or game, have parts of their eyes actually larger than ours, just as a blacksmith's arms grow larger by constant use.

Any part of our body that we do not use, finally becomes weak and helpless. Let the blacksmith change his work for that of a clerk, and the once brawny arms become smaller and weaker. We read of certain people in India, who, as an act of worship, keep one arm raised above the head until the muscles shrivel, and become useless.

All the parts of the body have so much to do with each other, that each one has some effect on all the others. Now, what we commonly call taking exercise — that is, walking, running, and jumping — not only strengthens our arms and legs and backs, but makes our blood flow faster and brisker. It makes us breathe in a great deal more fresh air, it helps us to get rid of more waste matter, it makes us warm and comfortable, and it keeps our digestive organs in good order. In brief, **exercise** makes us stronger and better all over.

What a good thing it is for boys and girls that they are so fond of play! Playing base-ball, running races, skipping with a rope, — all these games help

Questions. — What would happen to any part of our bodies should it get no exercise? Of what use is walking, running, and jumping to boys and girls?

them to grow up into active, healthy men and women. The old adage says, "Change of work is as good as play." There is a sense in which it is quite true. If we have been sitting and reading a long time, it rests us to get up and take a walk. If we have taken a long walk, it rests us to sit down and read. In these ways change of work is as good as play, because it is a real change, and exercises quite a different part of our bodies.

23. Time for Exercise. — The best time to take exercise is about two hours after a meal. It is not best to do hard work or take severe exercise before breakfast. Those who go to work, or study, before breakfast, should first eat a little plain food, or even drink a glass of milk, just enough to "stay the stomach." Just after a full meal, the stomach is busily doing its duty: hence severe exercise at this time is apt to hinder its action, and results sooner or later in ill digestion.

The evening is not the best time for exercise, because the body is tired after the labor of the day. It is useless to make any exact rule for any one person. Ordinary work or moderate exercise, as walking, is healthful at almost any time, except just after a full meal.

Questions. — How do you explain the old adage which says, "Change of work is as good as play"? What is the best time to take exercise?

24. Different Kinds of Exercise. — The kind of exercise depends very much upon one's daily work. Persons who sit at desks, stand at counters, or work in close rooms, as clerks, teachers, tailors, and printers, are apt to suffer from a lack of bodily exercise and from foul air. Every person should learn by careful observation to know his own needs and his own dangers. All sound persons should every day do some work or take some exercise with both body and mind. To get and to keep vigorous health, it is not at all necessary to increase the size of our muscles very much, or to do great feats of strength.

Walking is the best of all exercises. It takes us into the open air and the bright sunlight; it puts new life into many important muscles of the chest, abdomen, and limbs. With a brisk walk every day, taking care to keep warm and dry, no one need suffer from lack of proper exercise. Running, leaping, climbing, and other vigorous sports, are well enough if we do not get over-tired. Violent sports, such as base-ball and foot-ball, are severe exercises, and occasionally dangerous. Rowing is admirably suited to most persons of either sex. Horseback riding, coasting, swimming, and skating are important helps to increase bodily vigor.

Questions. — What classes of persons most need exercise, and why? What is the advantage of walking as an exercise? Explain why we should be careful with violent sports.

The quick and graceful gymnastic exercises practised in many of our schools are especially healthful, and should be more generally used. Growing children should be trained every day, at home or in school, in the use of light wooden dumb-bells, light clubs, or wands. A daily exercise of ten minutes will do much to develop feeble and narrow chests, to check a tendency to curvature of the spine and round shoulders, so common with young people, and to give strength and vigor to all parts of the body.

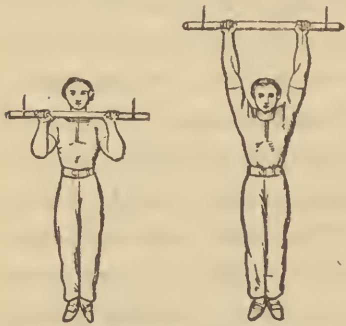

FIG. 22. — Exercise on the Swinging-Bar.

One of the simplest and most useful modes of light gymnastics is, to fasten a broomstick in some suitable place in your house, suspending it securely over your head as high as you can reach. Exercise several times every day in this way: swing, hanging by both hands; after a while with one hand, and drawing the body up to the stick. Physicians often work wonders by similar means towards improving the health and developing the lungs of feeble children. (Fig. 22.)

Collateral Reading. — Blaikie's *How to Get Strong, How to Stay So*; Blaikie's *Sound Bodies for our Boys and Girls.*

Question. — What is the advantage of light gymnastics?

25. **Effect of Alcohol on the Muscles.** — If a person drinks more or less alcoholic liquor, the muscles are acted upon in a peculiar way. Why so? Because the nerve-force that governs the muscles is weakened, and they show a lack of control. Every one is familiar with the unsteady and staggering gait of a drunken person.

The delicate movements which require the long training of certain muscles, as in handling fine tools and doing gymnastic feats, cannot be done. An intoxicated person may know the right way of making each movement, and may succeed, after a fashion, in doing it; but, when a certain point of intoxication has been reached, this is impossible.

Under the influence of alcohol, the trained muscles become feeble and trembling, and are no longer wholly under the control of the will. The rapidity with which this loss of control is produced varies greatly with the individual, with the kind of liquor, the rate at which it is taken, and many other circumstances.

Note. — The subject of physical training, especially in our schools and colleges, has been ably discussed by Professor Edward M. Hartwell of Johns Hopkins University, in one of the "Circulars of Information of the Bureau of Education," published by the United-States Government, No. 5, 1885.

Questions. — What is the effect of alcohol on the muscles? Why is this true?

CHAPTER IV.

WHAT WE EAT AND DRINK.

26. **Why we need Food.** — Our bodies, as you have been told before, are in some respects like a steam-engine. Our food is to us what coal is to the engine. Like the locomotive, our bodies move about, and are warm, because a fire is always burning in them. This fire, like that of the engine, needs fresh fuel from time to time. Without fuel and air, the fire in the engine will go out. So it is with our bodies: without food and air, the bodily fire would soon go out, and we should die for want of them. When coal or wood is burned, we get ashes. So, too, in our bodies: we produce not exactly ashes, but something like them, which must be got rid of, else the fire would flag.

Again: each and every part of the steam-engine is always wearing out. So it is with our bodies: we are all the time wearing out. Every beat of the heart, every movement of a muscle, the wink of an eyelid and the twist of the tongue, even our very

Question. — In the matter of work, waste, and repair, how does the human body resemble a steam-engine? Illustrate.

thoughts, — all these lead to waste. Every step we take, every word we speak, wastes a little bit of our bodies. In short, we are working and wasting all the time, at the expense of some tiny portion of the body.

Then, why do we not waste away? We weighed this morning just as much as we did three days ago; some of us, we hope, a little more. How can this be? Why, we have been doing something else, part of the day, besides working and wasting. This something was to eat our dinner yesterday and our breakfast to-day. This is the whole story. What we eat and drink takes the place of what is used up or wasted. If we are young and growing, we must take in a little more than the actual waste. Nearly all this waste is made good by our **food** and **drink**: the rest of it comes from the air we breathe.

The food we eat, you will think, does not look much like our bodies, of which it is to make a part. Perhaps we may think the meat is rather like it; but how about bread, milk, butter, and potatoes? How are all these things turned into flesh, hair, and bone? How, indeed, does it ever get to them, — to our knees, fingers, toes, and eyes, for instance? Let me tell you in four words: *the blood carries it.* The blood not only carries away the waste matter *from*

Questions. — Why do we need food? How does the food which we eat and drink, and the air we breathe, become a part of our bodies?

every part of the body, but also brings nourishment *to* every part. In brief, as the Bible says, "The blood is the life."

27. Tissue Foods: the Albumens. — What a great variety of articles we eat and drink! Is this a good or a bad thing? A good thing, as we shall soon see. Many unnatural things are eaten for food in certain parts of the world. Thus certain tribes of Indians in South America eat a peculiar kind of clay. Beetles were eaten by Roman epicures, and are said also to be eaten by Turkish women to make themselves fat. Bees, moths, ants, mice, and many small animals, form staple articles of diet in other countries. Humboldt, the great traveller, tells us that centipedes are eaten eagerly by some of the natives of South America. Locusts and grasshoppers are eaten by the Digger Indians in the West.

We can easily put all ordinary foods into three great groups. First, we have certain kinds of food to make up for the wear and tear of the body; that is, **tissue foods,** or **albumens,** so called because they build up the tissues. They are called albumens because they contain a whitish substance called albumen. The white of an egg is a familiar illustration: it is almost wholly made up of albumen. Lean meat, the cheesy part or curd of milk, pease, and beans are

Questions. — What is meant by tissue food? Name the most familiar examples of albumenous food.

rich in albumen. Wheat, barley, oats, rice, and corn also contain albumen. All these foods hold something which in its usual form is a gas, and makes up a large part of the air around us. This is nitrogen: it is never found by itself in the body, but is always combined with other things. Our muscles and blood are especially rich in nitrogen. We are using up and getting rid of it every moment. Hence, to make good this loss, we must eat tissue-making food, or else we should slowly starve to death.

28. Fuel Food: the Sugars and Starches. — Now, while some foods are chiefly useful as flesh-formers, — that is, they mainly go to make new flesh and new bone, — other foods more especially make heat, and enable us to do work. These fuel or heat-giving foods have no nitrogen; but they do have much of a well-known element called carbon, known in another form as charcoal. We may divide them into two classes, — the **sugars** and **starches**, and the **fats**.

We might, perhaps, think that all our sugar comes from sugar-cane, and must be bought at the grocer's; but this is quite wrong. There is a little sugar in wheat, and a good deal in some other things we eat, such as pease, oatmeal, beets, honey, milk, grapes,

Questions. — What gas does all tissue food contain, and why is it necessary to our bodies? Of what use are the sugars and starches?

watermelons, and many other articles. Sugar is very easily digested; it is dissolved in the mouth by the saliva, and then passes down the food-pipe into the stomach, where it is taken up by the blood-vessels. In the blood the carbon of the sugar combines with another element, called oxygen, and makes heat.

The sugars and starches form a large part of all those plants commonly used as food. Wheat, barley, rye, oats, rice, corn, arrowroot, sago, and potatoes are rich in starch. In its natural state, starch is useless as food until it has been acted upon by the digestive fluids.

When starch is well chewed, it is changed into sugar by the action of the saliva. This is why a piece of bread tastes sweeter after it has been in the mouth for a few minutes. Old people with poor teeth, and young people too, indeed, often like the crust of bread, or the heel of a loaf, especially if it is soaked in milk or tea. Why? Because it is sweet; and it is sweet because, having been baked harder, the starch has been partly changed into sugar. We seldom, however, keep the food long enough in the mouth to change all the starch of our food into sugar; this is done farther along in the act of digestion, as we shall soon see.

Questions. — Of what use is the sugar to the body after it has been digested in the stomach? From what sources is it most abundantly obtained?

29. **The Fats.** — Some people, especially children, do not like fat; some of us may have a feeling of disgust at the mere thought of it. But we all must eat **fat** in some form or other. We are familiar with this class of food, under the names of pork, fatty meat, suet, lard, butter, olive-oil, and cod-liver oil.

Fat is rich in carbon, and another element called hydrogen. It is a heat-giving or fuel food. Its two parts, the carbon and hydrogen, combine with the oxygen in the blood, and make much heat. We know how brightly and quickly fatty substances burn in the air when set on fire. Now, they burn just as well in the body, but much more slowly; thus making a gentler heat, but one which lasts a longer time. For this reason, fatty foods are much used by people who live in cold countries. The Esquimaux, who live in Greenland, drink one or two quarts of oil, and eat several pounds of tallow candles, every day. Their children, it is said, have as keen a relish for tallow candles as our children have for bananas or ice-cream. Sir John Franklin once tried to find out how much fat an Esquimau boy could eat. Fourteen pounds of tallow candles quickly disappeared; and Sir John, feeling alarmed for his stores, closed the experiment with a large piece of fat pork.

Questions. — Name another class of heat-giving food. How is the body supplied with heat from the fats? Why are the fats eaten by people who live in a cold country?

Oil is a luxury greedily devoured by the Northern races, as was amusingly proved in a seaport town some years ago. The town was lighted with oil-lamps, and it was noticed that they went out early for several successive nights. At last it was discovered that some Russian sailors in the harbor climbed the lamp-posts and drank the oil. Once upon a time some English sailors made a "Christmas-tree" for some Esquimau children by tying together some walrus-bones, and hanging on them balls of whale-blubber, instead of bonbons. This was a rare treat for the children, who ate the balls of fat as eagerly as we would eat chocolate-creams.

30. The Mineral Foods: the Salts and Iron. — All the foods we have just studied come from living things, as animals and vegetables. Besides these, we must eat certain things which have no life, and never had. We will call these **mineral foods.** First of all, water is a mineral food; but this will be described more fully hereafter. We cannot do without common salt as an article of food. All nations, both civilized people and savage tribes, eat it daily, both by itself and along with other food. The lower animals like it too. Farmers put lumps of salt in their fields for the sheep and cows to eat. Wild animals flock in great numbers to places known as salt-licks.

Questions. — Explain what is meant by mineral food. Explain the importance of salt as a food.

Men have risked their lives to get even a taste of salt. In olden times untold tortures were inflicted upon prisoners by feeding them on bread alone, and that made without salt. In most countries it "is as cheap as dirt," while in parts of Africa it is worth its weight in gold. Salt has always been the symbol of life, hospitality, and wisdom; and the Scriptures tell us, "Salt is good. Have salt in yourselves, and have peace one with another."

How much salt do you suppose we have in our bodies? About half a pound, but we are all the time losing it. Tears, we know, contain salt; and it is also found in the sweat. Some may think they do not eat any salt, because they do not eat it by itself. But we must remember that many foods we eat, as meat, oatmeal, and cheese, have just a little of it.

Now, we need some other salts to help purify the blood. These are the salts of potash, found in the vegetables, especially lettuce. Sailors who have been forced to go for a long time without fresh vegetables always suffer much from a fearful disease called scurvy. In Lord Anson's celebrated expedition round the world, which left England in 1740, four out of five of the original crew died of scurvy. Again, we all need, especially growing children, salts

Questions.—About how much salt is contained in the human body? Of what use to the body are the salts obtained from eating vegetables?

of lime to make the bones harder and stronger. This is one reason why children should eat plenty of bread and milk.

Would you think that we need any iron in our food? Well, we do; for it is iron that helps to make good blood, and to color it a bright-red hue. Iron in small amounts is found in many of the foods we eat. Some years ago, as the story is told, a certain gentleman desired in his will that his body should be burned instead of being buried. His friend, a famous chemist, saw that his wish was gratified; and, collecting the ashes of the body, he obtained from them enough iron to make a mourning-ring.

31. **Water as a Food.** — Pure water is our great natural drink. Many savage nations know no other drink, and require no other. Water helps to change our food into the blood, dissolving it in the stomach just as it would in a glass. A lump of sugar put into a glass of water soon disappears, but we know it is still in the water by its sweet taste. Not only is the greater part of our drink water; but bread, meat, potatoes, fruits, and other foods, also have water to make them easy to digest. Nearly three-fourths of the weight of our body is made up of water; in fact, every tissue and organ in the body is watery.

Questions. — Of what use is iron in our food? How does it get into the body? Explain the importance of pure water as a food.

How important it is, then, to have the water we drink pure and fresh! We are all the time getting rid of a great deal of water, — nearly two quarts every day, — through the skin, lungs, and kidneys: hence we must take in water every day to make up for this loss, besides what we drink. Certain foods, as lettuce, cabbage, apples, fish, potatoes, and lean meat, are more than three-fourths water. Water alone will prolong life if nothing else can be had. A few years ago, as some of us remember, it was claimed that Dr. Tanner lived forty days without taking any other food than water. There is a well-known case of a miner who lived twenty-three days, buried in a coal-mine, without swallowing any thing but water sucked through a straw.

32. **Important Articles of Diet.** — The most important food is bread, "the staff of life," without which we should indeed be poorly off. There is no single food in the world which meets so many real wants of the body. Bread may be made from the flour of many kinds of seeds, — such as wheat, oats, barley, rye, and Indian corn; but in this country it is nearly always made from wheat. Wheat-flour gives us starch, sugar, and a kind of albumen called gluten; hence wheat has nearly every thing to sup-

Questions. — Name some articles of diet that contain a large proportion of water. What can you say of the importance of bread as an article of diet? What is nearly a perfect food, and why?

port life, except fat. When we eat bread and butter, we have nearly a perfect food.

Corn-meal is a highly nutritious and cheap article of food. Oatmeal and milk is a very cheap and nutritious article of diet. The famous Dr. Johnson once spoke of oats as "food for men in Scotland, and horses in England;" and a sturdy Scotchman added, "Yes, indeed; and where will you find such men and such horses?"

Rice, though rich in carbon, is one of the least nutritious of all the cereals. Pease and beans contain more nitrogen than any of the cereals, and are as rich in carbon as is wheat-flour. The common or Irish potato is a most important article of diet; although it is more than two-thirds water, and has little nutriment, yet it is easily digested, and is a cheap and economical article of diet.

Ripe fruits, such as apples, pears, peaches, melons, grapes, and oranges, though not of much nutritious value, are prized for their agreeable flavor. Sugar and molasses are both largely used in cooking and confectionery.

Among animal foods, milk is the simplest and best. It is, indeed, a model food. It has flesh-forming, bone-making, and heat-giving material in

Questions. — What can you say of corn-meal as an article of diet? of rice? of the ripe fruits? Of the animal foods, which is the best, and why?

the right proportions, especially for children. What a wonderful thing is an egg! It has a great amount of nutriment packed away in the smallest space, and is easily digested. Its value as food is equal to that of the same weight of meat.

Meats, for the most part, consist of the muscles of the various animals. The most common are beef, mutton, lamb, veal, and pork. Meat is rich in albumen, and has more or less of fat. It is a most important article of diet, and, as a whole, is easily digested, except, perhaps, veal and pork. Fish is at once a cheap and nourishing food. Poultry is easy to digest, and gives a deal of nourishment, especially for the sick. Like all fats, butter is almost entirely a heat-giving and force-making food. Cheese is nutritious, but is not easily digested.

33. **Artificial Drinks.**—Man has always contrived many ways to flavor his drink. The greater portion of almost every drink is water, but in various ways other substances are mingled with it to give it a pleasant taste. Such drinks have always been highly prized by all nations. Tea, coffee, cocoa, beer, wine, and distilled liquors are the more common artificial drinks. All such beverages rank as articles of luxury, and not as real necessities of life.

Questions.—Name the meats used as food that are easily digested; that are hardest to digest. What can you say of fish? poultry? butter and cheese? Name the artificial drinks.

34. Tea and Coffee. — Tea and coffee are useful additions to the diet. They gently stimulate the nervous system, producing a slight feeling of excitement and a relief from fatigue. Coffee is especially useful as a stimulant after severe labor, great exposure, and hard study. Soldiers, sailors, miners, and others exposed to hardships, will thrive on scanty food if well supplied with coffee. If taken in moderation; tea and coffee seldom do harm. Some persons, however, cannot drink a single cup of coffee or of tea without feeling the worse for it; headache, indigestion, heartburn, wakefulness at night, and costiveness are the most common effects.

Strong tea in large quantities should never take the place of ordinary food. Hard-working women and others too often make their meals of dry toast and several cups of strong tea. Such a habit is sure to result in indigestion. Taken in excess, tea may weaken the action of the heart, and produce the peculiar beating, after much exertion, known as palpitation: hence we have the "tea-drinker's heart." Coffee and tea are hurtful articles of diet for growing boys and girls.

35. Alcohol. — When the juice of apples is first pressed out, it is sweet. If kept warm, or allowed to

Questions. — In what way may coffee and tea be made useful additions to the diet? In what way may they be made to do harm? What may be said of their effects upon growing boys and girls?

stand, it soon begins to "work," or ferment. The new cider loses its sweet taste, begins to bubble, and becomes of a very different taste and odor. The sweet cider has become hard. The sugar has changed into a gas called carbonic acid, and into **alcohol,** which gives a peculiar flavor. The juices of all kinds of ripe fruit will soon begin to "work," or ferment, in the same way. The starchy grains of corn, rye, barley, and other cereals, if kept warm and moist, are rapidly changed into sugar, and then into alcohol. This change is called fermentation. Thus wine is fermented grape-juice, and cider is fermented apple-juice. The carbonic-acid gas partly evaporates, and partly remains to give life to the liquor.

The intoxicating principle is the **alcohol,** which, when once taken up by the blood, acts upon the body in a remarkable manner.

Alcohol is a clear, colorless liquid with a burning taste. It is lighter than water, and mingles freely with it. It has a penetrating and peculiar odor; it has never been frozen; it burns readily, giving much heat and but little light. Alcohol is a staple article of commerce, and is used extensively in various trades and professions.

Almost every drink that intoxicates contains more or less alcohol. Such beverages may differ a great

Question. — What is alcohol? describe its properties.

deal, as much as old cider does from rare wine, or the costliest brandy from the cheapest whiskey; and yet the intoxicating power is always there, due solely to the alcohol each contains.

36. Principal Drinks that contain Alcohol. — Under the name of "beer" may be included lager-beer, ale, and porter. Beer is very extensively used as a beverage. Compared with distilled liquors, it has a small amount of alcohol. Wine is made from the sweet juices of fruits, which are pressed out, allowed to ferment, and then bottled.

By heating a fermented liquid, the alcohol in it can be readily driven off in the form of vapor; this is condensed in a cool receiver, and the result is a new and stronger liquor. This process is called distillation. The alcohol of commerce is distilled from whiskey. Beverages thus distilled are commonly known as "spirits" and "ardent (burning) spirits." Brandy is distilled from wine, whiskey from fermented corn and rye, gin from barley and rye, and rum from fermented molasses. Distilled liquors contain from forty to fifty per cent of alcohol, the rest being water flavored with various aromatics. Enormous quantities of alcoholic beverages are used in almost every part of the world. The effect of alco-

Questions. — Mention some of the principal drinks that contain alcohol. What is distillation? From what articles are these principal drinks distilled?

hol upon our bodily life is a subject of the most profound importance.

37. **Alcohol as a Food.** — A certain portion of a small dose of alcohol serves, like tea and coffee, to hinder the waste of the tissues in a very limited way. Scientifically speaking, then, alcohol has been held by some as a food in the widest sense of the word. Now, because alcohol is regarded by some as a possible food, it by no means follows that it is a safe food. In fact, it is plainly evident to any sensible person that alcohol is so dangerous an article of diet that practically we do not call it a food, but a *poison*. Certain poisonous drugs, arsenic for example, given by doctors as medicines, hinder the waste of the tissues; but we certainly should not on this account class or use them as food.

As a beverage, alcohol in its various forms is the deadly enemy of human life, either from a physical, moral, or intellectual point of view. The position of alcohol as a substitute for ordinary food, or as an addition to it, cannot be correctly defined without reference to its effects upon the nervous system, — effects so rapid, so far-reaching, and so poisonous, that its influence upon the general nutrition is of little account.

38. **Alcohol and Work.** — Does alcohol enable us

Questions. — Why is not alcohol a safe food? What can be said of it as a beverage?

to do more work? Many interesting experiments have been tried to test this point. At first alcohol may give a slight and short renewal of strength, but it is only for a moment. It is rapidly followed by a diminished ability to work. How shall we explain it? Let me tell you. We shall learn in a following chapter that alcohol increases and weakens the beat of the heart, and lowers the bodily temperature.[1] Hence, because the pumping-engine of the body is working more feebly and faster, and because there is less heat in the body in consequence of the alcohol, it is not at all strange that the power to do muscular work should be lessened.

Hence men who are in training for boat-racing, base-ball, foot-racing, and other sports where great exertion is called for, are never allowed to use alcoholic liquors. The recent war in the Soudan showed that the British soldiers could endure the hardships of war in that hot country better without alcohol than with a regular ration of strong drink.

Questions. — Does alcohol enable us to do more work? What does Dr. McSherry say on this subject?

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[1] "Alcohol is quite capable of damaging each and every organ and tissue of the human body; and, furthermore, its victim transmits mental and physical disease, or strong tendencies thereto, to succeeding generations. Hence, alcohol becomes a dangerous instrument, even in the hands of the strong and wise, a murderous instrument in the hands of the foolish and weak." — RICHARD MCSHERRY, M.D.

CHAPTER V.

DIGESTION, AND HOW IT GOES ON.

39. **What is meant by Digestion.** — When a sick person is very feeble indeed, especially from the loss of blood, the doctors sometimes do a remarkable surgical operation : they open the sick person's vein, and inject warm milk or beef-tea, or perhaps fresh blood directly from another person's veins. They inject enough of this to revive the sick man, and thus perhaps save his life. But no one would ever think of feeding a person many days in this unnatural way. Of course, the best way to be fed is by the good old mode of eating and drinking.

A part of what we eat is not nutritious, and would clog up the body instead of feeding it. The waste part of the food, therefore, must be got rid of ; but the nourishing part, after it has gone through many changes, and has had some things added to it, becomes at last the living fluid called blood. Can any thing be more wonderful than that flesh and vegetables, and bread and water, and other things that have no life in themselves, should, when once taken

Question. — Explain what is meant by digestion.

into the body, change into living flesh, living bone, living skin?

The process by which food is thus made fit to mix with the blood is called **digestion.**

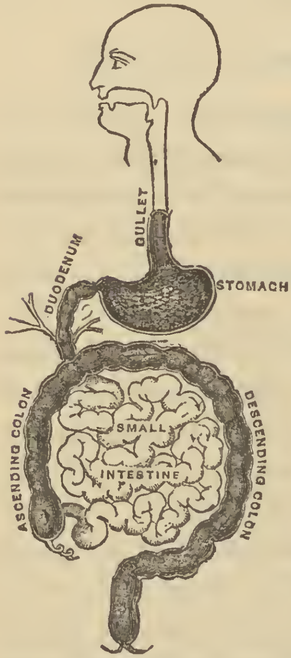

FIG. 23.—Diagram of the Digestive Canal.

In a general way, we may compare this process to a vegetable-garden, where side by side, from the same soil, grow pease, corn, tomatoes, pungent horse-radish, and sharp peppers,—and poisonous weeds by the fence on the edge of the garden.

40. What takes Place in the Mouth. The Teeth.—The food is broken into pieces in the mouth by the **teeth,**—valuable little jewels, of which the jaws are the jewel-cases (Figs. 24 and 25). During our lifetime we have two sets of teeth. The first set, twenty in number, begins to appear when a child is about six months old. A child may really be born with teeth. Some day you will read in your history that Louis XIV., a great

Question.—Describe the two sets of teeth.

king of France, Richard III., a wicked king of England, and Mirabeau, a famous French orator, were born into the world with teeth.

When we are about six years old, the first set, commonly called the milk-teeth, drops out; and the second or permanent set of teeth, thirty-two in num-

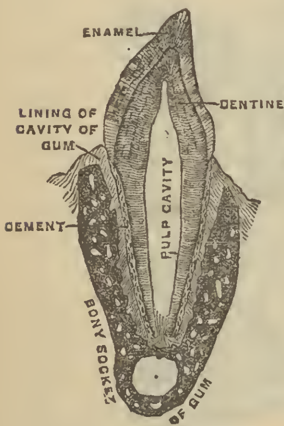

FIG. 24.—Vertical Section through a Tooth lodged in its Socket.

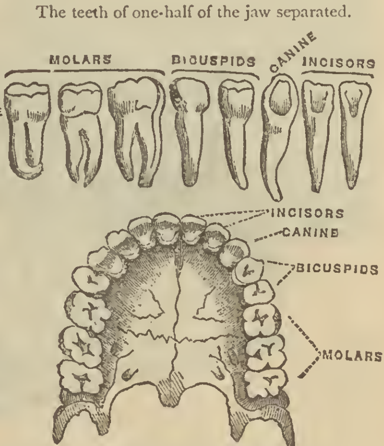

Fig. 25.—The Teeth.

ber, gradually takes its place. Each tooth is set down into a socket in the jaw-bone, like a post in a hole. The teeth are coated with a thin layer of a very hard substance, called enamel. Each tooth has inside a fine tube filled with blood-vessels and nerves (Fig. 24). When a tooth is decayed, and the nerve is open to the air, it makes it ache.

Questions.—What can you say of the structure of the tooth? Explain the cause of tooth-ache.

As some of you know, it hurts to have a tooth pulled out. Cruel men have taken advantage of this fact, and used it as a means of torture. In some countries they used to pull the teeth of those convicted of offences against the law. Louis XI., a cruel king of France, tortured the children of his

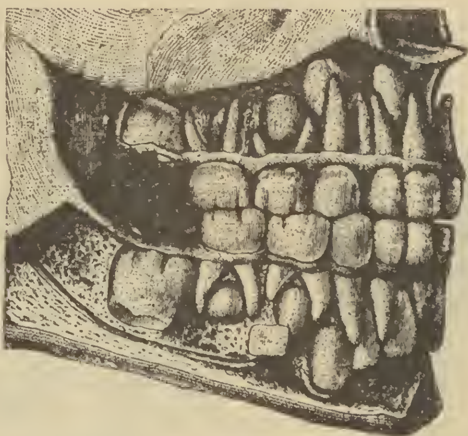

FIG. 26. — Section of Jaws, showing the Milk and Second Teeth.

nobles in this way. In early English times, gold was thus cruelly wrested from rich money-lenders.

41. Mixing the Food with Saliva. — The food, chewed by the teeth, is rolled around by the tongue, hard pressed against the roof of the mouth, and then swallowed. During this time the food is well mixed with the fluid of the mouth, called **saliva,** which

Question. — Explain the work performed by the teeth and the tongue in preparing the food for digestion in the stomach.

flows from a number of little spongy organs inside the mouth (Fig. 27). Probably you have had the "mumps," or at least have seen some friend who has had the disease. What is it? Why, sometimes these little organs, of which there is one under each ear, become inflamed, and grow large; and this is known as the "mumps."

FIG. 27.—One of the Salivary Glands.

The saliva wets the food, and so makes it easier to swallow. It has, besides, another very important work to do: it acts on the starchy part of the food, changing some of it into sugar. You know that a piece of bread grows sweet in the mouth when it is well wet with saliva. This work of the saliva is important, else starch could not be dissolved, and therefore would do us no good as food, while sugar is readily dissolved.

When we are not eating, the saliva flows only in small quantities, just enough to keep the mouth comfortably moist; but when we begin to eat, these little factories do a brisk business, and pour into the

Questions. — What is saliva? what office does it perform?

mouth a large quantity, about half a pint, it is said, at a single meal. The sight, or even the thought, of a savory dish, will make the saliva flow, or, as we say, "make the mouth water." The sight of a piece of meat will make the saliva run out of a hungry dog's mouth. Run your finger to and fro in the mouth several times, and notice how quickly the saliva flows.

Smoking and chewing tobacco cause an undue amount of saliva to flow from these glands, thus making the mouth dry. The constant spitting of tobacco-juice wastes the saliva needed to digest the food, and after a time causes ill digestion.

We can now understand how necessary it is to chew our food well with our teeth before swallowing it. If we eat very fast, and bolt our food nearly whole, we get little good from it. It does not digest easily, and sooner or later we shall suffer for our negligence.[1]

42. How the Food is swallowed. — The food is now ready to be swallowed. The soft, moist mass, pushed into the back of the mouth, is forced down

Questions. — Why are smoking and chewing tobacco injurious to the digestive organs? In what other way may the digestive organs be impaired?

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[1] "If the food reaches the stomach imperfectly masticated, the process of digestion is delayed, and as a result the stomach may become dilated. The habitual drinking of large quantities may cause dilation of the stomach." — Professor WILLIAM H. WELCH, *Johns Hopkins University.*

the **gullet**, or food-pipe, by a peculiar motion something like the waving of the skin of a worm's body when it is crawling. If you watch a horse's neck when he is drinking, you will see the peculiar motion

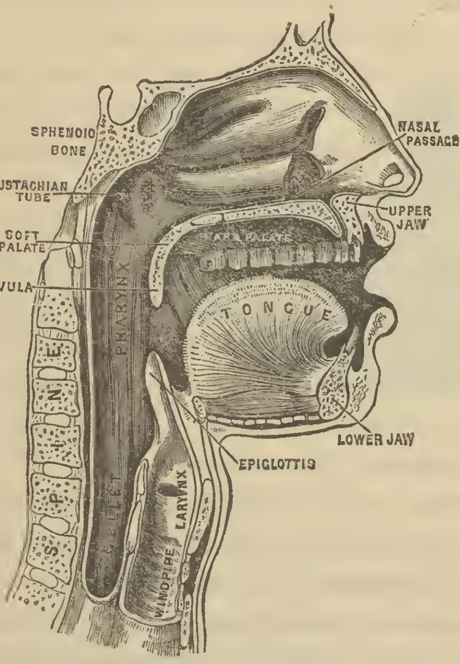

FIG. 28 — Section showing Passages to the Gullet and Windpipe.

along his food-pipe. A wave of motion follows just behind the food, and pushes it down.

Another hollow tube, in front of the gullet, opens into the back of the mouth, — for you know it is as

Question. — How is the food swallowed?

necessary to breath air into our lungs as it is to take food into our stomach, — and this other tube, or wind-pipe as it is called, is therefore for the air to go down. If the food were to slip down the wind-pipe instead of the food-pipe, we should be choked to death. We all know, when a bit of food goes "the wrong way," how we have to cough until we get it up. In order, then, to prevent mistakes, the top of the wind-pipe is protected by a trap-door.

A very clever fellow this little trap-door is. When we are just going to swallow a morsel of food, down it goes quick and tight, and keeps the food out of the wind-pipe; but, as soon as the food is down, up jumps the trap-door, so as to let air pass down to the lungs. This wonderfully useful little servant does not have any common name, but is called the *epiglottis*, meaning, "upon the tongue."

43. **What takes Place in the Stomach.** — The food, a moistened, partly digested mass, has now reached the **stomach** (Fig. 29). This is a pear-shaped bag, capable of holding about two quarts. It lies across the upper part of the abdomen, a little toward the left side. The size of the stomach depends upon what there is in it. As we fill it with food, it swells out larger, like a toy balloon, which becomes smaller or larger according to the amount of air in it.

Questions. — Explain the action of the *epiglottis* in swallowing. After the food is properly masticated and swallowed, where does it go?

The stomach has two openings, — the gullet end, through which the food enters; and the out-going end, a kind of muscular ring. This out-going end, called the "gate-keeper," is made in such a wonderful manner that any food trying to get through too soon is sent back again, so that only properly digested food is allowed to pass. Would not that carpenter be called a very clever man who could make a door which would open and shut of itself at the right time, which would let only the right sort of people go in, and would crowd away the wrong ones?

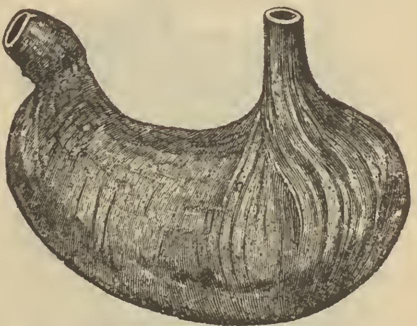

FIG. 29. — The Stomach.

As we begin to eat, the walls of the stomach stretch themselves out to make room for the food, and begin to move gently with a wavy motion, which carries the food round and round, as if it were being churned. This churning motion is slow and gentle at first, but gets faster and faster as digestion goes on.

As soon as the food arrives in the stomach, thousands of tiny glands in its walls pour out on the food

Question. — Tell all you can about the stomach.

a fluid called the **gastric juice.** This flows in great abundance, — several quarts, probably, every day, — and has in it a peculiar substance something like yeast, called "pepsin," which is necessary to the digestion of food in the stomach. The gastric juice dissolves, and thus helps digest, that part of food which has albumen in it, — the lean meat, gluten of flour, and so on.

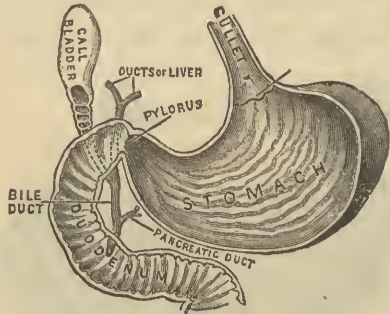

FIG. 30. — Section of Stomach.

A part of the contents of the stomach, being easily dissolved, and so already sufficiently digested *in* the stomach, need not go any farther, but is readily absorbed through its walls; while the other contents, needing further digestion, have to pass on into the intestines.

If we could only see all these wonderful things going on inside of us, especially in the stomach! It would be more instructive than watching the bees make honey through the glass windows of their hives. Well, do you know that the inside working of a man's stomach has really been watched through

Questions. — What is the gastric juice? Explain its action upon the food.

an opening in his side? About sixty years ago a Canadian named Alexis St. Martin was accidentally shot in the left side. After much pain and suffering he recovered; but the opening into the body never healed up, but remained a kind of window through which his doctor could look in and see what was going on in his stomach. The doctor saw the gastric juice pour in upon the food, and he found that some things were much more easily digested than others. He also discovered that, when the young man ate things which were unwholesome, the inside of the stomach became red and inflamed, and did not do its work properly.

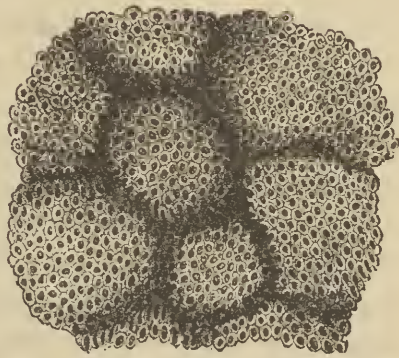

Fig 31.—The Inside of the Stomach, showing the Opening of the Glands, highly magnified.

Thus we see that the stomach has a great deal of hard work to do: it is a busy workshop, where all that is eaten is partly made ready for the use of the body. It was a favorite saying of Frederick the Great, that "an army moved on its stomach."

Question.—What happens inside the stomach when we eat unwholesome food?

44. How the Intestines do their Work. — The gate-keeper of the stomach now opens his gate for the partly digested food to pass out into the long tube known as the **intestines,** or the bowels. This tube is about thirty feet long, but it is so rolled up and folded away in the body that it takes up very little room. In the first foot of the intestine, the food is mixed with two fluids which flow into it through two little pipes (Fig. 30). One is of a greenish-yellow color, called the bile, which is made in the **liver;** the other, called pancreatic juice, by the **pancreas,** or sweetbread as we call it in animals.

The liver is so important a part of our bodies, that we must learn a few things about it. It is the largest organ in the body, and weighs about five pounds. It is on the right side, in the upper part of the abdomen, and its lower edge is sometimes easily felt just below the ribs.

The **bile** is made by the liver, and stored up in a little pear-shaped bag attached to the liver, called the gall-bladder. This little bag is made aware, in the twinkling of an eye, when the food enters the first part of the intestines, and straightway pours out its greenish fluid. The next time the cook cleans a fowl, ask her to show you the little greenish bladder which she calls the gall, and which she takes

Questions. — Describe the intestines and their work. What two juices aid in digestion here? Describe the liver.

care not to burst, because it holds a bitter fluid which, if spilt upon the fowl, would quite ruin its flavor.

The liver is a very busy workshop; in fact, it does double duty. It is the great rag-picker of the body. It makes, out of the waste matter of the blood, the bile which is so necessary to our health. Again, the liver is a storehouse, storing up a kind of sugar, which is gradually doled out to the blood as it is needed for the use of the body.

The fat we eat is not digested in the mouth or stomach, but in the first part of the intestine. The bile helps divide the fat into the tiniest pieces, and so fits it to be taken up by the blood. The fluid from the sweetbreak also aids in the digestion of fat, finishes the digestion of the starchy foods not already changed into sugar by the saliva, and carries on the digestion of other foods which the stomach has failed to do.

45. How the Blood feeds on the Food. — Now that the food has been acted upon by the digestive fluids, and has become a thick, creamy mass, it remains for us to see how the rich, nutritious part is to get into the blood. This is done chiefly by two sets of vessels, — the **blood-vessels** and the **lacteals.** This process is called **absorption.** The inner lining of the

Question. — What fluid is manufactured here, and what can you say of its use? After the food has been properly digested, how do the nutritious parts get into the blood? What is this process called?

digestive tube is richly supplied with blood-vessels. Certain parts of the food can readily soak through the delicate walls of these vessels, and so are taken directly into the blood.

Again, the inside lining of the intestines is not smooth, like the outside, but has a velvety appearance (Fig. 32). Millions of short, velvety threads, called "villi," meaning tufts of hair, hang down, like very small tongues, into the inside of the intestines. They are tiny affairs, about one thirtieth of an inch long, and a five-cent piece would cover five hundred of them. They have the look of the pile on plush. We are, of course, familiar with this appearance in tripe.

FIG. 32.—Piece of Inner Surface of Intestine, showing the Villi.

In each one of these villi is a network of the finest blood-vessels, and a tube called a lacteal, meaning "milky," because it carries a white, milky fluid. Millions of these lacteals dip down into the intestines, like little root fibres, and suck up, like so many open mouths, the fatty matters of the food from its creamy contents. The lacteals, after passing through a number of glands in the abdomen, like way-stations on a railroad, unite into larger tubes, and finally open into a little sac in the loins.

Question.—Explain the action of the lacteals.

Leading upward from this is a tube about eighteen inches long and about as large as a lead-pencil, called the *thoracic duct,* which carries the fluid upwards

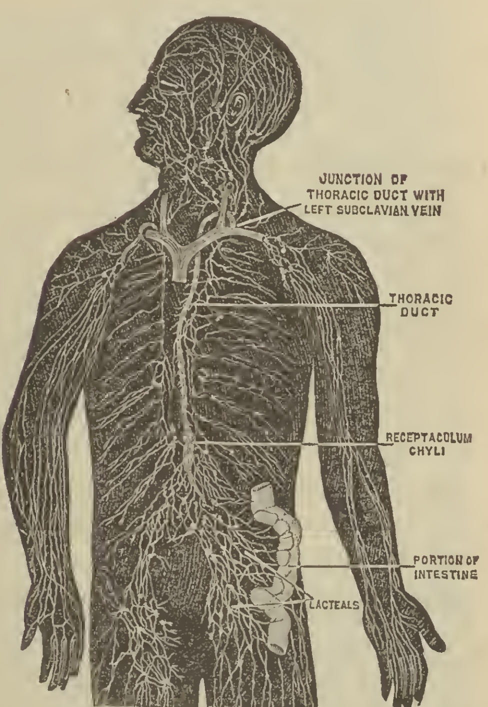

FIG. 33. — Lacteals ending in Thoracic Duct, which empties into a Vein in the Neck.

beside the backbone, and pours it into a large vein situated close to the heart.

The nutritive matter thus absorbed from the food leaps into the blood-current, carrying with it a renewal of life and power. The life of the body is thus, as

you see, supported by the nutritive part of the food, every drop of which will turn into blood, — the blood which flows through our hearts, nourishes our limbs, and is flushed into every nook of our bodies.

The lower part of the intestines is a kind of temporary storehouse for undigested and waste matter, which must be got rid of as speedily as possible.

46. **How much to eat.** — The quantity of food needed to keep the body in good health varies very much. The greater the amount of exercise, the more food is needed to make up for the waste. During the time of growth, a still greater quantity is needed to build up new tissues: hence growing children generally have a good appetite and a vigorous digestion. The same holds good of persons getting well of some long and wasting sickness.

The quantity required also depends very much upon one's business. Those who work hard and long, either with the body or mind, as teamsters, blacksmiths, farmers, doctors, and editors, need a goodly amount of nutritious food. Those who work indoors, as clerks, milliners, students, and bookkeepers, can get along with a smaller quantity. In cold weather and in cold climates, a greater quantity of fuel-food is necessary than in warm weather and in a tropical climate.

Question. — What may be said of the quantity of food needed to keep the body in good health?

An appetite for plain, well-cooked food is a safe guide to follow. Every person in good health and

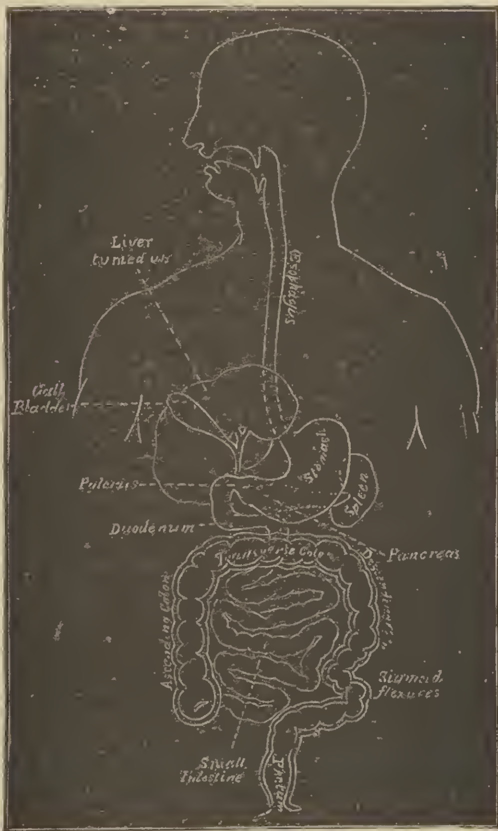

FIG. 34. — Blackboard Diagram of the Digestive Canal.

with moderate exercise should eat well: he should have a keen appetite for his food, and enjoy it.

Young, growing, and vigorous persons should eat slowly, and until the appetite is fully satisfied.

It is easy to know when we are eating too much. An overloaded stomach makes itself known by a sense of fulness, uneasiness, drowsiness after meals, and sometimes a real distress. If we keep on eating too much and too rich food, as growing children are apt to do, the complexion becomes muddy, the face marred with blotches and pimples, the breath has an unpleasant odor, and the general look of the countenance is dull and unwholesome.

47. **What to eat.** — Food should be both nutritious and digestible. It is nutritious in proportion to its capacity to furnish suitable substances to be taken into the blood. It is digestible according to the ease with which it is acted upon by the digestive fluids. Certain vegetable foods are both nutritious and digestible. A man will grow strong and keep healthy on any of them.

The splendid races of Northern India live on barley, wheat, millet, and rice as their staple food. In Southern India, millions of people live on pease and rice. Many generations of the hardiest men in the world, in the North of England and Scotland, have lived on oatmeal and milk. The Roman gladiator was trained on barley; and the Roman soldier en-

Questions. — Name some general rules to be observed in eating. When is food said to be both nutritious and digestible?

dured his long marches and severe fighting on grain boiled in water, when meat could not be had.

We may safely eat some animal food every day, yet the vegetable albumens supply all that is needed for the nourishment of the body. Solomon briefly puts an important lesson upon this point: "Excess of meats bringeth sickness."

William Cullen Bryant, one of the hardest literary workers of our times, died at the age of eighty-four from an accident. His breakfast was made of hominy and milk, with a little fruit. He ate meat only once a day. For supper, no tea, but bread, butter, and fruit. Yet when he was over eighty he could do more literary work on this simple diet than most ordinary men of middle age.

Beef, pork, ham, oysters, and rich pastry should be given sparingly to young people. The plainest and simplest diet is the best. It is much better for a child to go to bed on a supper of oatmeal, baked apples, or mush and milk, than of hot biscuit, cake, pie, and fried meat; better to begin a day's work with a breakfast of oatmeal, stale bread, a soft-boiled egg, and a glass of milk, than of strong coffee, sausage, and hot bread. Frying food is the worst possible mode of cooking it, and should never be done when it can be avoided.

Questions. — What is said of the value of vegetable food to the human body? What is the best food for children? What kind of cooking should be avoided?

Some persons are made sick by eating certain articles of food which to most people are harmless. Some are thus affected by various kinds of shell-fish, others by eggs or by fruit. The story is told of a lady who could digest hard salt-beef, but who suffered dreadful pain if she ate a single strawberry; one person was thrown into convulsions whenever he ate onions; Francis the First, a king of France, could not eat bread; and there are several cases recorded of people who had to avoid apples and cheese. Experience is the only guide for us as to what will disagree with us; and for this reason we have given only hints, not rules, for selecting your daily articles of food.

Eating too frequently, as well as too much at a time, will cause indigestion. The stomach is not an organ intended, as is the heart, to be constantly at work: after it has done its work, it requires a short period of rest. Most articles of food need from three to five hours to digest.

48. When to eat. — Three meals a day, from five to six hours apart, arranged according to our occupation, should be eaten. The stomach, like other organs, does its work best when its tasks are done at regular periods: hence regularity in eating is of

Questions. — What should be the best guide in the selection of our food? Name two of the most common causes of indigestion. Why should we eat regularly?

the utmost importance. Eating out of meal-times should be strictly avoided, for it robs the stomach of its needed rest. Children should not be allowed to eat "between meals." Food eaten when the body and mind are very much fatigued is not well digested. Rest, even for a few minutes, should be taken before a full meal. It is a good plan to lie down, or sit quietly and read, fifteen minutes before eating.

Severe exercise and hard study just after a full meal are very apt to stop digestion. Remember the story of the two hounds. Both were fed alike in the morning. One was taken out on a hunt, the other was tied up at home. When the master came back from the hunt, both dogs were killed, and their stomachs examined. It was found that the dog that hunted, still had the stomach full of food, while that of the stay-at-home was empty.

The reason is plain: after a full meal, the vital forces of the body are called upon to help the stomach digest the food. If they are forced, instead of this, to help the muscles or brain, digestion is hindered, and a feeling of dulness and heaviness follows. This in time often results in the common form of ill digestion called "dyspepsia." Healthy persons rarely need food for two or three hours

Questions. — What care should be observed before and after eating? Repeat the story of the two hounds.

before going to bed. When we are asleep, all the vital forces are at a low ebb, and digestion is difficult.

We should make it a point not to skip a meal unless forced to do so. Children, and even grown-up people, often have the bad habit of going to school or to work in a hurry, without eating any breakfast. There is sure to be an "all-gone" feeling at the stomach before another meal-time; and this, if neglected, is sure, sooner or later, to cause serious injury to the health.

The state of the mind has a great deal to do with digestion, as with the use of every other part of the body. An old Eastern fable tells of a traveller who met the Plague coming from Bagdad.

"You have been making great havoc there," said the man, pointing to the city.

"Not so great," replied the Plague. "I killed only one-third of those who died: the other two-thirds killed themselves with fright."[1]

Sudden fear or joy, or any startling news, may take away the appetite at once: hence, so far as we can, we should laugh and talk at our meals, and drive

Questions. — Why do we not need food just before going to bed? What habit should be avoided?

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[1] "We too often lose sight of the interdependence of the mind and body; but none the less is it impossible to separate the two, and train either independently of the other; for, as was well said by Sterne, 'The body and mind are like a jerkin and its lining. If you rumple the one, you rumple the other.'" — EDWARD M. HARTWELL, M.D., *Johns Hopkins University*.

away all anxious thoughts and unpleasant topics of discussion. If hunger is a good sauce, so also is a jolly laugh.

49. **How to eat.** — Eat slowly, and chew the food thoroughly. It is not only bad manners to eat rapidly, but it is a violation of the simplest law of digestion. Our teeth were made to chew the food, and the saliva to moisten it and help along digestion. If the food is taken slowly, and well chewed, the saliva and the gastric juice act more readily.

Do not take too much drink with the food. If we do so, the flow of the saliva is checked, and digestion is thus hindered. Do not take the food and drink too hot or too cold. Such substances as very hot bread and coffee injure the enamel of the teeth, and are digested but slowly in the stomach.

Drinking freely of very cold water when the body is heated, is also a dangerous practice, and, aside from its ill effects on digestion, has occasionally resulted fatally. It is a poor plan to spur on a flagging appetite with highly spiced food and bitter drinks. An undue amount of pepper, mustard, horse-radish, pickles, fancy meat-dressings, and highly seasoned sauces, may stimulate digestion for the time, but, used in excess, soon weaken it.

Questions. — Explain the importance of being cheerful at meal-time. Name some important rules on how to eat. What is said of drinking cold water and eating highly spiced foods?

50. Care of the Teeth. — We should take the very best care of our teeth, and keep them as long as possible. Teeth are apt to decay. We may inherit poor and soft teeth. Our ways of living may make bad teeth worse. If an ounce of prevention is ever worth a pound of cure, it is in keeping the teeth in good order. They should be thoroughly cleansed night and morning with a soft brush and warm water. Castile soap, and some simple tooth-powder with no grit in it, may be sometimes used. The brush should be used on the inner or back side of the teeth, as well as on the front side.

The enamel once broken or destroyed is never renewed; the tooth is left to decay, slowly but surely: hence we must be on our guard against certain things which hurt the enamel. Picking the teeth with pins and needles is hurtful. We should never crack nuts, crush hard candy, or bite off stout thread, with the teeth.

Dirty and decayed teeth are a frequent cause of an offensive breath and a foul stomach. We should exercise the greatest care to save the teeth. The last resort of all is to lose a tooth by having it pulled. Some one has quaintly remarked that to lose a grinder is very much like losing an old friend.

51. Indigestion due to Alcohol. — Drinking alcoholic liquors, especially in the morning on an empty

Question. — How may the teeth be preserved?

stomach, results in alcoholic indigestion. A person begins with a slight loss of appetite for breakfast, "spits cotton-wool," has a dull headache, and feels a little sick at the stomach. He is peevish and irritable, and is not comfortable until he has a drink of liquor. After "bracing up his stomach," as he calls it, he feels more like eating: hence arises the craving for "morning bitters," cordials, wormwood, and other things, to excite an appetite. After eating, there is a dull, heavy feeling of discomfort. With the old drinker of ardent spirits, there is in the morning a dry throat, trembling of the tongue, and a thirst which amounts to real suffering.

52. **Effect of Alcohol on Stomach Digestion.** — Alcoholic liquors are a mild or a strong irritant of the stomach, just as they are taken raw or diluted, or in small or large quantity. Their habitual use leads to most distressing forms of stomach disease. The color of the inside of a healthy stomach is a deep pink, like the inside of the mouth and throat. Now, if we could look into the stomach, as Dr. Beaumont looked into the stomach of Alexis St. Martin, just after taking raw spirit, we should find that the inner surface would be bright red, far more so than after taking ordinary food. In fact, Dr. Beaumont himself says, that, when Alexis drank

Questions. — In what does the regular drinking of alcoholic liquors result? What is said of their habitual use?

brandy and gin in large quantities, he saw that the inside of his stomach became covered with red patches, and the food he ate was not properly digested.

Alcohol irritates the lining of the stomach, and dilates the tiny blood-vessels, just as brandy dropped into the eye would make it look red and fiery.

Alcohol, like any other irritant, also makes the gastric juice flow; but it lessens the power of the gastric fluid to digest food, by checking the activity of its pepsin. The injury to the liver from alcoholic liquors also adds to the disturbance in the stomach.

Now, when this alcohol irritant is poured into the stomach for days, weeks, and even for years, it is no wonder that the stomach becomes altered in its structure. The walls of the stomach become thicker and harder, and after death traces of deep sores are found.

53. **Effect of Alcohol on the Liver.** — When alcohol is taken up by the blood-vessels of the stomach, it is carried to the liver, and filtered through this great organ before it reaches the heart. Hence the poisonous effects of alcohol are strongly marked in the liver, especially among hard drinkers. The blood-vessels of the liver are overworked, and are engorged with blood.

Questions. — What effect will alcohol have on the lining of the stomach? on the gastric fluids? Why are its poisonous effects more marked in the liver than in any other organ of the body?

Many different diseases are produced, some enlarging and others contracting it, but each serious and fatal. A liver which has become contracted from alcoholic excess is so common, and its cause is so well known, that it is spoken of in every-day language as the "gin-drinker's liver."

"Alcoholism is a powerful predisposing cause of pleurisy."—Professor FRANK DONALDSON, *University of Maryland, Baltimore.*

"Many cases of dyspepsia are due to alcohol, solely and wholly." —J. MILNER FOTHERGILL.

"Nothing with such certainty impairs the appetite and the digestive power as the continual use of alcoholic liquids."—POVY, *on* "*Food.*"

CHAPTER VI.

THE BLOOD, THE RIVER OF LIFE.

54. **The Blood: what it is, how it looks.**—We all know how blood looks to the naked eye. It is a red fluid, which thickens, or clots as it is called, when much of it is shed outside of the body. Let us not be too sure that the blood is red. It is really not red at all, being nearly as colorless as water. Then, why does it look red? Let me tell you. The red color is due to millions of little red bodies, called **corpuscles,** which are swept along in the blood-current like tiny red fishes in the rapids of a river (Fig. 35). There are so many of them that they make the blood look uniformly red. Fill a clear glass bottle with the smallest red beads, and then with pure water: the water would then look red at a short distance. Imagine the clear waters of a brook alive with little red fishes; sup-

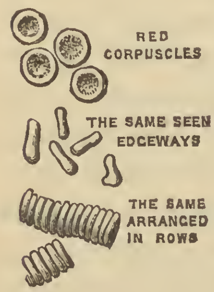

Fig. 35.—Blood Corpuscles.

Questions.—What is the blood? Explain how it gets its red color.

pose the fishes to be very, very small, and closely crowded together through the whole depth of the stream: the water would look red, would it not? In a single drop of blood, there are about five millions of these bodies; so you see that they are very tiny affairs, and very numerous. If we had fingers delicate enough, we could pack about fifty thousand of them on the head of a pin. The shape of these little corpuscles is something like that of a cent.

Of what use are these red corpuscles? All the use in the world. They have the power of taking up gases as a sponge can take in water. We shall study in the next chapter something about the oxygen that we breathe *in*, and the carbonic-acid gas that we breathe *out*. Now, these red corpuscles are the oxygen-carriers for the blood. We may compare them to a countless fleet of little boats, carrying their precious cargoes of oxygen to every part of the body. A very busy life these corpuscles live. Night and day, whether we are asleep or awake, these tiny oxygen-carriers are busy as bees.

If we beat up some fresh blood in a bowl with an egg-beater, we find entangled some white, sticky threads, which are easily seen after the coloring-matter has been washed away. This is called **fibrine**, — a kind of glue used by nature to stop bleeding, by

Questions. — Of what use are these red corpuscles in the blood? What is fibrine, and what is its use?

making a plug for fresh wounds; otherwise we might bleed to death from even a slight cut. Again, if we fill a tumbler half full of fresh blood, and let it stand over night, we shall find in the morning it has separated into two parts. One, a sticky, jelly-like mass, called the **clot,** sinks to the bottom; the other, a straw-colored, watery fluid, called **serum,** is on top. Serum is made up of albumen dissolved in a great deal of water. We cannot boil it. Before we get it as hot as boiling water, it "sets" into a solid mass, like the white of a hard-boiled egg. It is the serum, which feeds the tissues of the body with nutritive material.

55. **The Circulation of the Blood.** — To circulate means to go around, and the **circulation** is so called because the blood goes round and round in the body. It is carried by a number of pipes, starting from the heart, and branching into all parts of the body. We know we can draw blood from any part of our bodies if we puncture it with a needle. In fact, there is not a spot on us the size of a needle's point which has not its own little tube filled with blood. Compared with these tiny blood-vessels, our needle is a huge stake, and tears not only one, but a thousand, of these little tubes, every time we draw blood with it.

This circulation of the blood has been understood

Questions. — Describe the serum, and explain its use. Explain what is meant by the circulation of the blood.

for only about two hundred and fifty years, and the man who made this great discovery richly deserves a few words. His name was Harvey. He was an Englishman, and a physician to the King of England. For many years before, learned men had a glimmer of light on the subject; but it was Dr. Harvey who put together all that had been discovered, and really found out the way in which the blood circulates in the human body. The good doctor died in 1657, nearly forty years afterwards; living long enough to see his discovery generally accepted, and himself honored as a benefactor of his race.

56. The Blood-vessels.—The pipes in which the blood flows *from* the heart are called **arteries,** meaning "air-carriers." Before the time of Harvey, learned men, not being able to explain the fact that the arteries were found empty after death, supposed that they carried air, and not blood, throughout the body. The pipes in which the blood flows *toward* the heart are called **veins.** Joining these two sets of vessels is another set of little pipes, called **capillaries.** This long name means hair-like, and probably learned men could think of no better way to describe their size than by comparing them to hairs; still, our delicate hairs, fine as they are, are really cables,

Questions.—By whom was the circulation of the blood discovered? Distinguish between arteries, veins, and capillaries. Explain the work of each.

and coarse cables too, compared to the capillaries. They form a network which serves as a passage-way between the arteries and veins. We may think of an artery and a vein as like two streets, and the capillaries like a host of little lanes, through which we must find our way to pass from one street to the other.

Suppose our eyes were sharp enough to watch one of the tiny corpuscles whirling round and round in the circulation of the blood, we should find it sure to get to the heart at last. In brief, the blood-vessels form a sort of ring, — a circle without a break in it. The heart is the centre of the circle.

57. **The Heart, the Centre of Circulation.** — The **heart** is the most wonderful little pump in the world; in fact, it is two pumps in one, a double pump. There is no steam-engine half so clever at its work, or so strong. We all know that our heart is in the middle of the chest, between the two lungs, with its pointed end turned towards the left side (Fig. 40). Here it is, then, beating like a watch, ticking all day and all night, year after year, never stopping, and never needing to be wound up.

The heart is somewhat like a strawberry in shape, and about the size of the closed fist (Fig. 36). It is a muscle, hence it can contract. When it is cut open, it is seen to be hollow inside, and is divided

Question. — Describe the heart.

into four rooms. First, it is divided right down the middle from top to bottom; and there is no door in the partition, so no blood can go from one side to the other. Then, each one of these halves is divided crossways. But this partition is not quite complete: it has little doors that constantly open and shut, which act like the valves of a pump. They open to let the blood through, and close to prevent its return. Let us now learn the names of these four rooms in the heart, and see what is going on in each. The two upper rooms are called the right and left auricles, the two lower rooms the right and left ventricles. In each, a blood-vessel either enters or starts off. Out of the left ventricle goes the largest artery in the body, a big pipe called the **aorta.** Did you ever notice a blackish thread running along the backbone of a fish ready for the table? Well, this is the fish's aorta. This great tube makes a horseshoe bend near the heart, and,

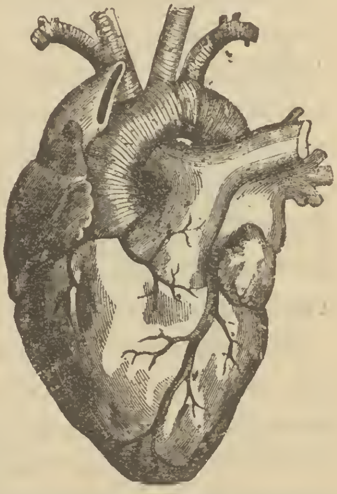

FIG. 36.—The Heart and its Large Blood-Vessels.

Question. — Describe the auricles, ventricles, and the aorta.

clinging close to the backbone, goes down towards the hips, sending out a great number of branches. Arrived at the loins, it makes a fork dividing into two great branches, which keep on going down, one on each leg, to the very tips of the toes.

Like the trunk of a tree, the arteries divide into branches again and again, and these into still smaller branches and twigs, until at last the capillaries are reached. The countless little capillaries then gradually join together as brooks unite to form a river, and make larger and larger vessels, called veins. By means of these the blood goes back to the heart through the two largest veins in the body, which empty into the right auricle.

58. What takes Place in the Lungs. — How does the blood get from one side of the heart to the other, since there is no opening in that partition which we told you about? Why, it goes around through the lungs, where it is changed from a dark color to a bright red, or, in other words, is purified by the oxygen of the air. The blood goes out of the lower room on the right side of the heart by a great tube called the lung artery. This divides over and over again into branches, in the substance of the lungs, until it makes a network of lung capillaries. These unite as they do in the body, and grow into

Question. — Tell what takes place after the blood reaches the heart.

veins which, gradually becoming larger and larger, all unite into four great veins, called lung veins, which empty into the upper room on the left side of the heart. From this side of the heart, the blood is pumped all over the body through the arteries. Thus the blood goes round and round in the body, making what is called the **circulation**; carrying nutriment *to* all the tissues, and bringing away dead matter *from* them.

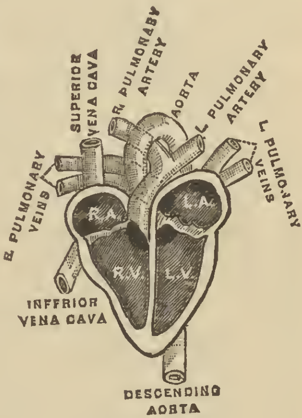

FIG. 37. — Diagram of the Heart and its Large Blood-Vessels.

59. How the Heart does its Work. — The heart is not simply the centre of circulation: it is also the power which drives the blood over all the body. It is really a vigorous little force-pump. Every time it beats against our side, it pumps into the arteries a fresh quantity of blood. The force given by this beat of the heart, added to the elastic pressure of the walls of the vessels, drives the blood through all the arteries, all the capillaries, all the veins, and back again to the other side of the heart. The heart does this because it is a sturdy muscle,

Question. — Explain the action of the heart in the work of circulation.

and can draw itself together with wonderful power. If you think for a moment, you will see, that, when the walls of a cavity become at one time shorter and thicker, they draw nearer together, and the space inside becomes very small. This is really what occurs in the four rooms of the heart (Fig. 37).

Let us follow a drop of blood in its travels around the body. It returns bright and red from the lungs to the left auricle; this chamber contracts, and the blood is forced down through the trap-door into the left ventricle; then this cavity contracts, and pumps the blood into the aorta; from that forcible impulse, on it rushes through all the arteries, capillaries, and veins, and is at last emptied into the right auricle, a dark, worn-out drop of blood. This chamber in turn now contracts, and crowds the blood down through the little swinging doors into the right ventricle; this cavity now contracts, and drives the drop of weary blood through the lung artery into the lungs to be purified. Then it is ready once more to go on its restless journey.

More wonderful still! How long do you think it takes the little drop of blood to go its grand round in the body? Only while you are counting twenty-two. All the blood we have, say about one-tenth

Questions. — Illustrate with a little drop of blood starting from the left auricle. How long does it take the blood to make a complete circuit?

of our weight, makes this complete circuit in two minutes. What a wonderful machine the heart is! It is busily pumping away, without getting tired, night and day, for threescore years and ten, and even a full century, seventy-two strokes every minute, over forty-three hundred times every hour, and nearly thirty-eight million beats every year. Let our heart come to a standstill for one minute, for a second even, and we cease to live.

At each stroke each ventricle pumps about four tablespoonfuls of blood. Nearly seven pounds of blood are moved every minute. How quietly this rapid stream of life flows on within us, never stopping for a second from birth till death! We feel nothing of it but the gentle tapping of the heart, and the regular throb of the pulse, as the life-blood goes on its ceaseless round.

60. The Pulse, and what it tells Us. — Press the wrist of a friend, laying three fingers over the outer bone of his arm, or press three of your own fingers over the same bone in your wrist. You can thus feel very easily the pulse or beat of the heart, because there is an artery at the wrist, which tells us exactly how the heart is working; and by feeling this, doctors can find out whether the blood is travelling through the body too quickly or too slowly,

Questions. — About how much blood is there in the human body? What is the pulse? What does it tell?

or just as it ought to do in health. You have probably seen an india-rubber tube on a garden-hose move on the grass at each stroke of the pump-handle. That is a pulse, and is exactly the same as the pulse in our large blood-vessels. The pulse is really everywhere in the body where an artery comes near the surface, as on the temples, the sides of the neck, and near the ankle.

Fig. 38. — Diagram of the Arterial System.

The doctor feels your pulse *at the wrist*, simply because it is more convenient for him to do so. Most of the arteries are more deeply buried in the flesh, where it is not easy to reach them.

In a healthy adult, the pulse beats about seventy-two times a minute. In children the pulse is quicker

Questions. — Why do doctors prefer the pulse at the wrist? In what way does the pulse show health and strength, or the opposite of these?

than in adults, and slower in old age than in middle life. Napoleon's heart, it is said, beat only forty strokes a minute. In certain diseases, especially in fevers, the pulse goes with great sudden leaps, like a galloping horse; in others it trots in little jerks; while in a feeble person it moves slowly and wearily, and its throbs are so weak that we can scarcely feel them.

61. Good Circulation, and how to promote it. — A proper amount of exercise enables all the organs of the body to do their work with more vigor. When we feel cold, a brisk walk or a lively game will "start the blood," make us feel warm. A daily bath, followed by a brisk rubbing of the skin with a coarse towel, promotes the circulation. Excessive exercise is, however, to be avoided. Like any machine, the heart may be strained by violent efforts. Gymnasts oarsmen, base-ball players, and others occasionally wrench the delicate machinery of the heart, causing oftentimes many years of ill heath.

Many of the veins lie so near the surface of the body, that the flow of blood through them is easily hindered by pressure: hence no article of clothing should be worn tight enough to stop the flow of the blood. Tight garters, by checking the circulation, often cause cold feet and chilblains. Tight collars

Questions. — What kind of exercise should we take to promote circulation? What is said of violent exercise? of tight clothing?

and clothing about the neck may cause dizziness and a feeling of fulness in the head. Bands, belts, and straps, and even boots and shoes, may be worn tight enough to hinder the free circulation of blood in various parts of the body. The health of the blood, like that of any other tissue of the body, may be promoted by a nourishing diet, pure air, and a proper amount of rest and clothing.

62. **How Alcohol gets into the Blood.** — Alcohol gets into the blood by two distinct routes. When we take alcoholic liquor into the stomach, some of it at once soaks through the coats of the tiny blood-vessels with which the lining of the stomach is covered, and is carried directly into the blood-current. Alcohol is also taken up by the lacteals, and is emptied into the blood through the thoracic duct. It takes only a minute or two for alcohol to get into the main blood-stream. A glass of strong drink soon "goes to the head," as many people know; showing that its effects are rapidly produced in the remotest tissues of the brain.

63. **Effect of Alcohol on the Circulation.** — The flushed face of a person who drinks ardent spirits is an every-day sight. It may seem to him and to others a sign of health, but it is really one of the many symptoms of alcoholic poisoning. The alcohol

Questions. — How does alcohol get into the blood? What causes the flushed face of a person addicted to alcoholic drinks?

has weakened the nerves which regulate the flow of blood in the vessels, thus allowing too much blood to flow through them. The arteries are relaxed, the capillaries are overflowing, and the undue amount of blood makes the skin look red. This action, which medical men call "congestion," we must remember, is not confined to the vessels near the surface of the body, but really extends to every organ and every tissue.

64. Effect of Alcohol upon the Heart. — The nerves have now lost their grip on the blood-vessels, and hence the heart has less resistance to overcome. Consequently it is forced to beat faster, and work harder, to fill the dilated vessels with blood. This increased frequency of the heart's stroke means more wear and tear, and less rest, for this vital organ. With this increased action, there are, to be sure, a flushing of the face, a feeling of warmth, and other marks of increased activity; but these are not lasting. This effect of alcohol is often called its stimulant action. It is not so much a real stimulant as a whip to spur the heart, for the time, to beat faster. It would be more exact to call it the beginning of the poisonous effect of alcohol.

Questions. — What effect does alcohol have on the heart?

CHAPTER VII.

HOW AND WHY WE BREATHE.

65. **What is Breathing?**—Night and day, without one minute's rest, from the first to the last moment of our lives, we are always breathing. About eighteen times every minute, more than twenty-four thousand times every day, we draw in and send out our breath. Most of the time we do not think any thing about it. Cats and dogs breathe; we see their sides move in and out, the same as our chests do. We notice the breath puffing out of a horse's nostrils as he rests after a hard trot. Even plants also breathe, doing it through tiny holes in their leaves, just as truly as animals, though in a different way. On cold winter mornings we see our breath like a cloud of steam. It feels cold as it passes in over the teeth; but it is warm as it goes out, for you know we can warm our cold finger-tips with our breath.

Breathing, both by plants and animals, is taking invisible air into the lungs, and sending it out again. Animals breathe by means of a wonderful

Question. — What is breathing?

and beautiful set of machinery, which we will now explain.

66. The Lungs, and how they look. — Strike the upper part of your right chest, just below the collar-bone, with the flat of your hand. Now strike the knee in the same way. See what very different sounds you get. The lungs lie on each side of your chest, just within the place you struck. The chest sounds quite hollow, about like a drum, because the lungs within it are full of air. How do the **lungs,** or "lights" as the butchers call them, look? They are two large, pinkish, spongy organs, a mass of air-passages, with arteries, veins, and capillaries, which extend to the collar-bone in front, and go down below the shoulder-blade behind (Fig. 39). The next time you go to the market, ask the market-man to show you the lungs or "lights" of a

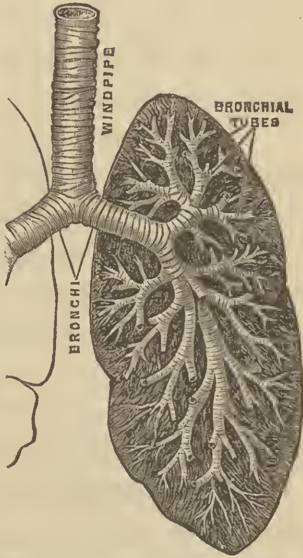

FIG. 39. — Windpipe and one of the Lungs.

Questions. — Why does the chest sound hollow when it is struck with a blow? Describe the lungs.

calf or sheep. Cut off a small piece, and examine it at home carefully. Take a piece in your hand, and you find you have something quite light and soft, which sinks under your finger if you press it, and rises again like a sponge. You will also notice a crackling sound caused by air being forced out of the air-cells. In fact, the lungs, like a sponge, are made up of a countless number of the smallest elastic cavities, into every one of which blood and air keep running, each on its own side, to bid good-day to each other, shake hands, as it were, and then hurry out as briskly as they came in.

67. The Air-Passages. — The air is drawn into the lungs through the mouth, nostrils, and windpipe. The **nostrils** are really the passage-ways for the air, and warm the air somewhat before it gets into the lungs. If you lean your head back, you can easily feel in the middle of the neck, in front, a stiff tube. This is the **windpipe,** which opens into the back of the mouth. There is a small lid of gristle in front of the open top of the windpipe, which, as you have been told before, is called the epiglottis (Sect. 42). It stands upright when we draw air in, and does not in the least prevent the breath from entering the windpipe.

The upper part of the windpipe is a kind of box

Questions. — Through what channels does the air get into the lungs? Describe them.

containing the organs of voice. In this box, easily seen and felt in spare people, and the front of which is commonly called "Adam's apple," are the **vocal cords.** These cords are not strings, but elastic strips, with free edges which can be made tight or loose. As the air passes to and from the lungs, through the narrow chink between these cords, it sets them to vibrating, and thus the sound called the **voice** is produced. During ordinary breathing, the vocal cords are widely separated.

The windpipe runs down through the neck into the chest, dividing into two branches, one going into each lung. It then divides into two others, and each of these into two more, and so on. Thus it goes on dividing into branches, the tubes becoming finer with every division, until the pipes are smaller than the tiniest hair. Every one of them has on its end a little hollow ball, called an air-sac, something like a red currant on its stalk, only much smaller than the smallest grain of sand. They are hollow, like tiny bladders; and around them, inside, are little recesses, like caverns in their walls: these are the air-cells (Fig. 41).

Imagine a short, thick tree, crowded with leaves; imagine the trunk and all the branches, even the

Questions. — Where are the vocal cords, and what is their use? Explain how the air reaches the inside of the lungs through the windpipe.

smallest twigs, to be hollow. Suppose the leaves were tiny bladders, blown up, and fastened to the smallest hollow twigs, and made up of some delicate but very elastic substance. Roughly speaking, so it is with the build of the innermost parts of the lungs. Around such a framework of hollow branches, called bronchial tubes, and hollow elastic bladders, called air-cells, is wrapped a finely woven network of arteries, veins, and capillaries, like a child's ball covered with a fine network of red and blue yarn. As the air fills the elastic cavities in the lungs, just as a boy blows up his toy balloon, the chest swells up; as the air is forced out, the chest sinks down again. Drawing in the breath is called **inspiration**; sending it out is **expiration.** The whole act of breathing is called **respiration.**

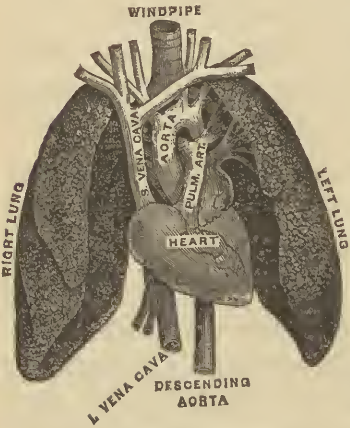

FIG. 40. — The Lungs and Heart (viewed in front).

68. How we breathe. — How do we draw our breath? Let me tell you the simplest things about

Question. — Explain the terms inspiration, expiration, and respiration.

it. First, the lungs are elastic. The air-tubes and air-sacs make up nearly one-half of the substance of the lung, and nearly the other half consists of blood-vessels. Both the blood-vessels and air-sacs are supported by a framework of elastic tissue. You know that you can stretch out a piece of elastic to a certain length, and then it springs back to its first size. Just so does this elastic tissue of the lungs act. It is stretched by the air being drawn into the air-tubes, but returns to its first size as soon as the inspiration stops, and so presses on the larger air-tubes, and forces the air out of them. Second, the lungs are fastened, on the under side, to a great muscle called the diaphragm, which we have told you about (Sect. 6). This is, as you know, stretched like a stout piece of rubber cloth between the chest and abdomen. In its natural position it bulges upwards in the middle, like a handkerchief swollen by the wind, and thus occupies a portion of the chest at the expense of the lungs. When we breathe air in, its muscular fibres tighten, and make it flat again, just as you make the handkerchief flat by tightening it. When the diaphragm relaxes, the lungs contract, causing their elastic tissue to shrink together again; and so the air is forced out of the larger air-tubes. This process is repeated over and over again, as long as we live.

Question. — Explain the action of the lungs and diaphragm used in breathing.

This faithful old servant, the diaphragm, quietly began his duties the moment we breathed for the first time. Since that time this sleepless guardian of our life has watched over every breath, and his last effort will be our last sigh.

The muscles between the ribs also contract and relax, and are thus useful helps in the act of breathing.

69. What takes Place in the Lungs. — There are two kinds of gas in pure air. The first is very lively and active, called **oxygen.** It is very fond of uniting with other things, and burning them. The second gas is a very slow, dull, stupid affair, called **nitrogen**; and nothing will burn in it. Oxygen, if quite pure, would be altogether too active a gas for us to live in, so kind Nature dilutes it for us with nitrogen.

FIG. 41. — The Air-Cells and Bronchial Tubes of the Lungs.

When the oxygen reaches the tiniest capillaries in the air-sacs of the lungs (Fig. 41), it is almost in contact with the blood itself. There is only a very, very thin membrane between the blood and the air. Now, experiments carried on outside

Questions. — What other muscles are also useful in breathing? Name the two gases contained in pure air. What happens when this reaches the lungs?

the body prove that gases can pass through delicate membranes. If a bladder filled with oxygen is hung up in a bottle filled with carbonic-acid gas, the two gases will mix with each other. The oxygen will pass out through the walls of the bladder, and the carbonic acid will pass in. This is called the "diffusion of gases." This is practically what occurs in the lungs. Thus there is an exchange, but no robbery. The red corpuscles of the blood exchange a poisonous gas for one which gives them new life.

We may, in brief, look upon the lungs as a kind of market-place or exchange, where two merchants, the blood and the air, meet to exchange their wares. About twenty cubic inches of air pass in and out of the lungs with every breath, or about what would fill sixty barrels every twenty-four hours. Indeed, it is a very busy market-place.

70. Changes in the Air from Breathing. — When we breathe, we do not simply draw in the air and send it back again. We breathe out some things which were not in the air when we took it in. One of these is **water.** On a cold, frosty morning, you know we see the clouds of vapor, or very fine drops of water, coming from our mouths. In hot weather or in a warm room we do not see this vapor, but it is there all the same. If we breathe on a looking-

Questions. — What is meant by diffusion of gases? How do we know that the air which is drawn from the lungs contains water?

glass, it becomes dim and damp with the water of our breath. There is, of course, a little watery vapor in the air, but hardly any compared to what there is in the breath.

We also breathe out a small amount of **animal matter,** — little bits of our own bodies, just ready to decay. This gives the air of an ill-ventilated or over-crowded room the close, disagreeable odor we all know so well. Pure air has no smell at all.

Again, we send out with every breath a kind of gas called **carbonic-acid gas,** which we can no more see than we can the air itself. Let me tell you of a simple experiment. Pour some clear lime-water into a goblet. Take a straw, or a sheet of stiff paper rolled into a tube, and blow through it into the lime-water. The carbonic-acid gas of our breath will rapidly make the clear liquid quite milky.

71. How Carbonic-Acid Gas may poison Us. — Carbonic-acid gas in its pure state acts as a deadly poison. If there is too much of it in the air we breathe, it poisons us. We soon breathe hard, get pale, faint, and dizzy, and after a time would die.

Every one has read the story of the "Black Hole of Calcutta." In the year 1756, a cruel tyrant in India, having captured a hundred and forty-six Eng-

Questions. — What can you say about animal matter drawn off with the breath? What gas do we get rid of in this way? Explain its nature.

lishmen, crowded them one hot night into a room where one little window did not admit enough air for the poor prisoners to breathe. They struggled and fought for the air, and in the morning only twenty-three were alive. After one of Napoleon's great battles, three hundred prisoners were crowded into a cave for safe-keeping, where in a few hours over two hundred died from the foul air.

In the mines this gas becomes the dreaded "choke-damp." Persons bent on suicide sometimes inhale the carbonic-acid gas from a little charcoal burning in a closed room. This same deadly gas sometimes flows naturally from the earth. Some of us have heard of the "Valley of Poison" in the island of Java. The gas is very abundant in this valley, and, from its weight, sinks to the ground, where may be seen, it is said, the skeletons of birds and animals which have been suffocated in their attempt to cross this death-trap.

72. **Pure Air, and how it is kept so.** — One would think that we should soon use up all the good air, and make it all bad. If we think for a moment what a great number of people there are in the world, — how many there are in great cities like Baltimore and Philadelphia, — breathing out the carbonic-acid gas from their lungs, it seems strange there is any air

Question. — Name some instances to show the poisonous nature of carbonic-acid gas.

left fit for us to breathe; for it is not only men, women, and children who must have oxygen to support their lives, but also every other animal. The little worms that live in their holes under ground want the oxygen of the air just as much as the cows and the sheep. Even fishes could not live if the water did not contain air enough for them to breathe.

Why does not the supply of oxygen ever fall short? What becomes of the carbonic-acid gas? First, let me tell you what it is made of: two very good things, — oxygen and carbon. A great deal of our flesh and blood is made of these two things; but when they are united, and make this gas, they are of no use to us. We might go to the store and buy salt and sugar; but, if they got mixed together as we brought them home, we could not use either, unless some good fairy could pick them apart for us.

Now, can anybody pick apart the carbon and oxygen in the carbonic-acid gas, and make them fit for us to use again? Yes, indeed. We have millions of workmen about us that are busily doing this very thing all the time. Every plant, every green leaf, every blade of grass, does this for us. When the sun shines on them, they pick the carbon out, and send back the oxygen for us to breathe. They keep the carbon, and make that fit for us and other animals to eat. Is not this a wonderful arrangement?

Question. — Explain how the air is kept pure.

How does all the bad air get out of the towns and cities, where men live, and get to the forests and plains? The wind carries it. Air is constantly moving about, rising up, falling down, sweeping this way or that way, and roving from place to place. In brief, as the Bible tells us, "the wind bloweth where it listeth [pleases]."

73. **How People poison Themselves with Bad Air.** — Let us now see some other ways in which air may be spoiled, besides by breathing it. Not only the little particles out of our breath, but many other things, may make it unwholesome. Even pleasant odors, like roses or lilies, are unwholesome if shut up in a room. Dirty walls, ceilings, and floors give the air a musty, close smell; so do dirty clothes, filthy sinks, and the contents of slop-pails. Some of these ought not to be in the house at all; others remind us to open our windows wide, and let in pure air.

While all we have told you about pure air applies to persons in health, it applies still more to sick people. First, because sick people need every possible chance to help them get well. They need good air just as much as they do good food. Second, because every thing that comes from a sick person's body is still more unwholesome than that from a

Question. — In what other ways is the air made impure besides breathing it?

healthy person, and may be a downright poison. Many learned men now believe that numerous diseases are really sown in our bodies by a kind of very small seeds or "germs," much as plants are sown in the ground. For instance, scarlet-fever, it is claimed, has its own seeds, or germs, which are shed in countless numbers from the body of a person who is suffering from it. Some of these float in the air; and, if we breathe them in, they are quite likely to give us the fever. The same may be true of measles, small-pox, whooping-cough, and other diseases.

Many other things make the air unwholesome. The foul air from chemical works, bone and soap factories, and many other manufacturing places, is more or less hurtful to health. Certain trades shorten life by exposure to air loaded with impurities. Thus there is the "miner's consumption," due to the dust breathed into the lungs. Those who work on steel, emery, pottery, etc., also breathe in the irritating dust floating in the air. Other impurities are highly injurious to the lungs, as the dust in match-factories, white-lead works, copper and brass founderies, and arsenic in wall-papers.

74. Ventilation, or how to get rid of Impure Air. — How are we to get rid of the bad air in our living-rooms, and to get in fresh air without being

Questions. — What is the supposed cause of the spread of many contagious diseases? What kinds of trades are unhealthy, and why?

too cold? In summer-time this is quite easy; but in winter it is more difficult, because it is very uncomfortable and often dangerous to be cold. It is a good plan to open your window at the top, which will let out the bad air. If you have a good fire and proper clothing, it is very seldom that you cannot bear the window open a little way at the top. Another excellent plan is to raise the lower sash, putting below it a strip of board two or three inches wide, the length of the window, and shut the sash on it. This leaves, at the middle of the window, an opening for fresh air. If two such windows are thus set on opposite sides of the room, it gives a constant change of air, and free from direct draughts.

Good ventilation is just as necessary by night as by day, because, of course, we go on breathing all night. People who take pains to shut in the bad and to shut out the good air, all night long, can never expect to awake refreshed. It is very unpleasant to go into the bedrooms of such people before they have left them in the morning. It is not strange that such persons are so often languid, pale, and peevish all the first part of the day. We hardly know why it is, people are so afraid of letting in night air, or what harm it is supposed to do. Those who have

Questions. — What is ventilation? Name some simple means to secure it. Explain the importance of keeping the air in the bedroom fresh and pure.

tried it know very well that they sleep better, and wake fresher, if they keep the air of their bedrooms clean and sweet all night. As the famous nurse Florence Nightingale aptly says, "What other air *can* we breathe at night?"

There is hardly a night in the whole year when it is not safe to keep a window open an inch or two at the top, and those who do so are not so apt to catch cold as those who do not. We must have, however, proper coverings on our beds to keep us warm.

75. **Effects of Alcohol and Tobacco upon the Air-Passages.** — Alcohol tends to bring on inflammation of the lung-tissues, and hence to lessen the breathing capacity. The wheezy, broken speech of the drunkard is due partly to an irritation of the air-passages, and partly to the thickening of the lung-tissue.

Again, the repeated stretching of the lung capillaries tends to make the habitual user of alcohol more liable to attacks of severe colds and pneumonia; besides making due allowance for the exposure to cold and wet, so common with the intemperate.

Breathing air full of tobacco-smoke is apt to cause sore throat. The habit of inhaling tobacco-smoke, or breathing it through the nose, is injurious to the throat and lungs. Cigarette-smoke is especially hurtful to the air-passages.

Questions. — What is said of the effects of alcohol on the air-passages? of tobacco?

CHAPTER VIII.

HOW OUR BODIES ARE COVERED.

76. **Getting rid of Waste Matters.** — When a fire in a stove or furnace burns, it uses up coal and wood, leaving behind dust and ashes; which must be got rid of, or before long the fire will go out. Our bodies are doing something very similar. They are all the time using up our fuel-food, and all the time making some waste matter which must be got rid of. There are three doors, or outlets, by which the body rids itself of its waste. One of these is the **lungs,** which carry of, as we havè seen, carbonic-acid gas, water, and animal matter.

The second is the **kidneys,** which filter off water holding a number of salts dissolved in it. The action of the kidneys is explained in more advanced books.

Let us now see how the third outlet of the body, or the **skin,** does its work.

77. **How the Skin looks.** — Our body is covered with a soft, elastic, tight-fitting garment, — the **skin.**

Questions. — In what three ways does the body get rid of its waste matter? Describe the skin.

It is easily kept clean, and never wears out. Every child knows how to run a fine needle through the outer skin without feeling it or drawing blood; but push the needle in a little deeper, and the blood will run at once. Why is this? Simply because there

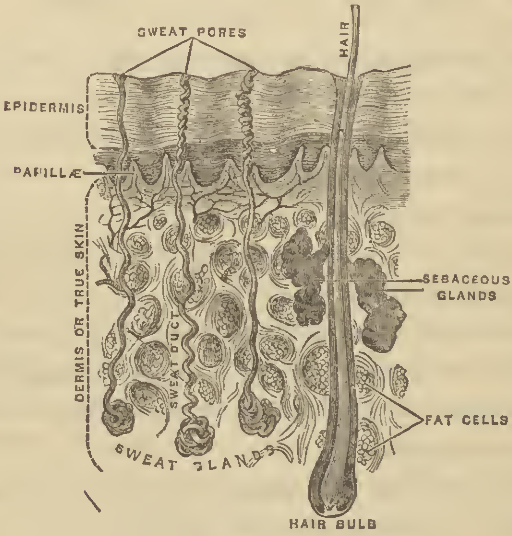

FIG. 42. — Vertical Section of the Skin.

is a lower, thick layer, full of the finest blood-vessels and nerves, called the **true skin.** The puncture of a pin, or the sting of the tiniest insect, causes pain.

We all know how very tender and painful is the delicate pink skin seen when the outer layer of the blister is torn away. This is the true skin. When it is destroyed, a scar results. Look and see if

you can find a white scar on your hand, due to a deep cut.

Over the true skin lies another layer of flat, horny, and lifeless scales, in which are no blood-vessels and no nerves. This is called the **scarf-skin,** or **epidermis.** We often give ourselves a little scratch, or pare a corn, without making the blood run, or feeling any pain. It is the scarf-skin which is raised into a blister when we burn our fingers.

The scarf-skin really consists of a countless number of little horny scales, laid one above another, as you might imagine the roof of a house would look with a dozen or more layers of shingles. The outer scales are all the time wearing out and rubbing off, and new ones are always forming underneath. A snake, as you may know, sheds its whole skin at once, as if a boy should crawl out of his clothes; and sometimes you may find in the fields its cast-off skin turned inside out, just as the snake squirmed out of it, and crawled off with a soft new dress on. Now, we shed our skin

FIG. 43.—The Scarf-Skin from the Palm of the Hand, showing the Pores.

Questions.—Describe the scarf-skin, or epidermis. Tell what is happening to this outer skin all the time.

a little at a time, and in such tiny powdery scales that we cannot usually see them. However, if we take any garment that has been worn next the skin, and shake it in the sunlight, we see how much dust there is inside of it. This dust is really little bits of the scarf-skin which have dropped off or worn away. Where the skin is pretty thick, as on the palms of the hands or the soles of the feet, we can, when we wash ourselves, see dead skin peeling off in little scales.

78. The Sweat: what it is, and where it comes from. — If we look at the skin on the tip of the fingers through an ordinary magnifying-glass, we see a great number of little holes, called pores. Just think how small they are! More than five thousand have been counted on the tip of one finger, and there are more than three millions of them in the covering of the whole body. Each pore is the end or opening of a tube called a sweat-gland. Each gland is a tiny tube just under the scarf-skin, rolled round and round like a ball of the finest silk. If all the sweat-glands in our body could be unrolled, and laid end to end like a long gas-pipe, they would be about four miles long. What work do these sweat-glands do? Why, a great deal of it. Let me tell you about it. Certain waste matter picked up by the blood is strained out through the thin walls of the

Questions. — Where are the pores? Describe them. What work do these little glands accomplish?

blood-vessels into the sweat-glands, up which it rises until it runs out of the openings, when it is called **sweat.**

If we hold the tip of our finger very close to a mirror, but without touching the glass, we see the place has become dim and moist. This is because the sweat has oozed out of the pores of our finger on the glass. If the mirror were held to any other part of the skin, it would become dim and moist just the same. Thus we see that the sweat-glands, if they are kept in good order, serve as little drain-pipes to rid our bodies of waste matters. When the weather is very hot, or when we are working hard, or are exposed to much heat, the sweat flows so freely that it stands on the skin in big drops; but at other times it flows more slowly. Still, it is always oozing out, even in the coldest winter weather. About two pints of sweat ooze every day through these busy little glands in the skin.

The skin is naturally soft, and the hair moist and glossy. What makes them so? Two little **oil-glands,** attached to each hair, furnish this natural dressing for the hair and the skin. We may call it Nature's hair-oil.

79. Why we need to wash ourselves. — A great deal of the sweat soaks into our clothing, so

Question. — Explain why the skin is naturally soft, and the hair moist and glossy.

that it needs frequent washing; but most of the moisture dries off into the air, and so cools the body. Some of the oily matter, however, sticks to the skin, and, together with the dirt or dust from the outside, makes a little plug, as it were, over the pores. The waste matter cannot filter through the skin, and has to stay in the body, or find its way out elsewhere. Suppose the drain-pipes which lead from a house got stopped up: we can imagine what an unhealthy state the house would soon be in. Just so it is in our body if the little pipes which drain the skin get clogged. If a person had his skin varnished all over, so as to stop up all the pores, he would die within a few hours. An instance proving this occurred at Rome many years ago, when the body of a little boy was completely covered with gold-leaf, in order that he might play the part of a cherub or an angel in a show. He was afterwards put to bed without the gold having been washed off; and, when his parents tried to rouse him the next morning, he was dead. It is said that the reason why the small-pox was so fatal among the Indians in this country was because they always kept the pores of their skin closed with bear's grease, to protect them against cold, and daubed themselves with earthy paints for the sake of ornament.

Question.—Explain the necessity of frequent bathing for all parts of the body.

How necessary, then, it is to have a clean skin, and to wear clean clothes! Many people think they have done quite enough if they wash every day their hands and faces, and the parts that are seen; but it is even more necessary to wash the parts of the body that are not seen, and are covered with our clothes, because all the dirt which comes from inside the body stays on the surface, and is not rubbed off, as it might be on our hands or faces.

80. **The Hair and the Nails.** — The **hair** and the **nails** really belong to the skin. The hair grows out from little sacs or bags in the skin, and so do the nails. Every hair has a little bulb or root, which is fixed in the skin, and soaks up the nourishment from the blood-vessels. It adds to our health and comfort to keep the hair clean. The oil-glands get clogged; and the dust and dirt, rapidly making a coating, commonly called "dandruff," on the scalp, get caught in the hair. Hence the hair should be often washed, combed, and brushed.

The color of the hair is given to it by little bags filled with coloring-matter. These are found in the hair and in the skin. In some people, especially old persons, this, Nature's paint-stuff, dries up; and the hair becomes colorless, or, as we say, begins to turn gray. When Nature spatters some extra drops of

Questions. — Explain the necessity of taking care of our hair. How does the hair get its coloring matter?

her paint here and there, especially on the face and arms, we call them freckles. Sudden fright or great sorrow will sometimes turn the hair white in the course of a few hours. It is said, that, at the time of the cruel Revolution in France, the hair of the poor French queen, Marie Antoinette, turned white in a single night, owing to the distress and agony of mind she suffered for the safety of her husband and her children.

The nails of our fingers and toes grow out from our skin, like broad, flat hairs, and are really only a kind of horny skin. They serve to protect the ends of the fingers and toes. Some people, especially school-children, spoil the look of their fingers by biting their nails; so that, instead of pretty oval, bright-pink, shell-like ornaments, as they should be, we see only ugly, stumpy fingers, with sore tips to them, which can feel nothing delicately or tenderly. The toe-nails require as much attention as the fingers. If we look at a baby's tiny foot before it has worn shoes, we see how pretty the little toes and nails are.

The finger-nails should be trimmed with scissors once a week, leaving them long enough to protect the ends of the fingers. Nails should never be

Questions. — What is the cause of gray hair? What useful purpose do the nails serve? How are their beauty and usefulness frequently injured by children?

trimmed to the quick. They should not be cleaned with any thing harder than a brush or bit of soft wood. They should not be scraped with a penknife or scissors, as these hurt their nice polish. To prevent hangnails, the skin should be often loosened from the nail, not with a knife or scissors, but with something blunt, such as the handle of a tooth-brush, or an ivory paper-cutter.

81. Baths, and how to take them. — It takes very little time, expense, or trouble to take a daily bath of some sort. A hand-basin, a sponge, a strip of cotton-flannel, a piece of castile-soap, a gallon of water, and a towel, are all that are required. Even rubbing the body every day, first with a damp towel, and afterwards very briskly with a dry one, will in most cases keep the skin clean enough during the week, provided a bath with soap and warm water is taken once a week. Most persons, especially the young and vigorous, soon get used to cool, and even cold, water baths.

The first effect of any cold bath is to shrivel up all the vessels of the skin, and make it look like "goose-flesh." Brisk rubbing will soon cause a glow, or bring on a re-action as it is called, after which a feeling of genial warmth is felt all over the person.

Questions. — What can you say of baths, and how to take them? After a bath, why is it necessary that the skin should be well rubbed with a coarse towel?

Coarse towels should always be used if the skin will bear it.

It is a good time for vigorous persons to take a cold bath just after getting out of bed in the morning. A bath at bed-time is refreshing, and favors sound sleep. There is little risk of taking cold if we go to bed at once. Young and feeble children should bathe two or three hours after breakfast.

Swimming in running fresh water or in the salt water has a wholesome effect on the skin, and is one of the healthiest of all exercises.[1]

Never go in swimming when the body is overheated or very tired. Better sit down quietly, and cool off for half an hour. Many are drowned every year from ignorance or carelessness in this matter alone. The risk is from sudden cramps, which cause even a strong swimmer to sink like a lump of lead. For the same reason, it is not safe to take a swim just after a full meal. Alexander the Great once nearly lost his life by swimming in a very cold river just after a meal.

Questions. — What is the best time for taking a bath? What does Prof. John S. Lynch say on this important question? What rule should be observed before you go in swimming?

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[1] "Bathing in proper season is also very useful. Sea-bathing, especially, has long enjoyed great credit; but it is often resorted to too soon, and practised at improper times. Due regard should be had to the power of resistance to cold, and the promptness of re-action after a bath." — Prof. JOHN S. LYNCH, *College of Physicians and Surgeons, Baltimore.*

82. Why the Body is warm. — Every one knows that the outside of the body is warm. If we get into a cold bed on a winter's night, our body soon warms it, and, however cold we feel at first, the heat of our bodies, like a fire always burning, keeps up the warmth of the bed. Put a little thermometer in your mouth, and close the lips around it for five minutes. What do we find? Why, on taking out the instrument, we find that the natural heat of the body is about ninety-eight degrees Fahrenheit, even on the coldest day of winter or the hottest day of summer.

Where does this heat come from? How does the body make this heat? Let me try to help you understand this by reminding you of what you have already been told about air in chapter vii. Oxygen is, as we know, very fond of joining itself with other things, and burning them. When oxygen joins itself with any other thing, it always makes some heat; and it is called a burning, whether there is any flame or not. We know that we are in some ways very much like a candle. Let me tell you of another way. When a candle is burning, what really takes place is, that the different things of which the candle is made unite with the oxygen to make carbonic-acid gas.

There is another gas in the candle, called hydrogen, which unites with the oxygen to turn into water.

Questions. — Where does the heat come from that keeps our bodies warm? Explain what takes place when a candle burns.

This goes on very fast indeed, and makes the candle very hot. Now, we know there is plenty of carbon in our bodies, and also plenty of hydrogen. When the oxygen of the air comes near them, they unite with it, and burn, as a candle does, and turn into carbonic-acid gas and water. This makes us warm. The great difference is, that they do not burn nearly as fast in our bodies as they do in the candle; therefore we do not flame and blaze up, nor are we nearly so hot as a lighted candle. A piece of fat, for instance, burns rapidly and brightly when put in the fire. But, if we eat the piece of fat, it will make just as much heat within our bodies as if we burned it in the fire. True, the burning will not be so rapid, nor the degree of heat produced so great; but it will last for a much longer time, and the total quantity of heat given out will be the same in both cases.

Hence our bodies are warm because we are burning away bit by bit, just as a candle does. Every time we move, feel, think, or, in fact, do any thing at all, this burning goes on. Thus our bodily heat is produced, and life is kept up. In brief, Nature warms our bodies on somewat the same plan by which we warm our houses with a coal-stove in the winter.

83. How the Heat of the Body is regulated. — How is it that the warmth of the body is the same

Questions. — Explain how the heat within the body is made. Why is the heat not so great in the body as it was in the candle?

at every season of the year and in every climate? Let me try to make this plain. If we put a drop of water, ether, or alcohol on the back of our hand, we feel the skin there grow colder; this is because the heat required to evaporate the liquid is taken from the skin. As the sweat evaporates from our skin, it produces cold. Now, the hotter the air outside of us, the more we sweat; but, as fast as the sweat comes out of the pores, it evaporates, and so more cold is produced. In this way the heat of the skin and of the blood is kept from rising much above ninety-eight degrees Fahrenheit. If the air outside is very cold, the pores contract, and very little sweat comes out of them. Thus, in summer and in hot countries the abundant sweating tends to cool our bodies; while in winter and in cold countries, since little sweating takes place, the body does not lose much heat.

Men who have to work in the midst of great hot furnaces, such as blacksmiths or workers in iron-founderies and glass-works, are no hotter inside their bodies than fishermen or teamsters. The blood may become hotter or colder from causes within us, — for instance, fevers make it hotter; want of food makes it colder, — but it has such a power of resisting the heat and cold outside the body, that persons have

Questions. — How is the heat of the body regulated? What natural causes may change the temperature of the blood?

been known to go for a few minutes into ovens hot enough to bake bread. Years ago there was a man, called the "Fire King," who could go into a red-hot oven, and stay five minutes. It was found, while he was in the oven, that the heat of his blood was exactly the same as when he entered it. We may be sure that he sweated profusely. It is because the blood always keeps at about the same degree of warmth, whatever the heat or cold outside, that people are able to live in all climates, and to bear all seasons. The Esquimau, who lives amidst the ice and snow of the polar regions, has as much warmth in his blood as the African, who lives under the scorching sun of the tropics. Man is the only animal that endures and flourishes in every climate of the globe.

84. Why we need Clothing. — A thin and delicate skin is our only covering. Why do we need any other? Why do we need clothing? Let me tell you. Our bodies are, as you know, much warmer than the air out of doors, so they are continually giving out their heat to the air. When our bare skin is exposed, we lose heat rapidly, and feel chilly and cold: hence we wear clothes to keep the heat of our bodies from escaping too rapidly into the air.

Is there another reason? Yes. In hot summer weather, especially in hot countries, the direct rays of the sun would scorch our skin. Again, clothes

Question. — Why do we need clothing?

save the skin from being torn or hurt by accidents. They also keep out the wet, so that we can better bear exposure to rain or snow. The frequent changes of weather, so common in this country, are a severe tax on the body, against which our clothes are our chief means of defence.

85. Hints about wearing Clothes. — Clothes should be changed according to the climate or season of the year. It is not prudent to leave off winter clothing too early in the spring, for our seasons are most uncertain. Woollen should be worn next the skin, whether in summer or winter. A most imprudent but common error is to take off our winter flannels early in summer because it happens to be warm. With our sudden changes of weather, a person may thus run great risk of taking severe colds, pneumonia, and even "quick consumption."

To keep our persons neat and clean, we must change our clothes often. This applies not only to garments used for daily wear, but to bed-clothes and night-clothes. No one should sleep in the clothes he wears during the day. Under-garments should be frequently and regularly changed. Bed-clothes should be exposed freely to the light and air. Young

Collateral Reading. — BULKLEY'S *Skin in Health and Disease.* PACKARD'S *Sea-Air and Sea-Bathing*, "American Health Primers."

Questions. — Name a few safe rules for changing our clothing. Give some other reasons for frequent changing.

children are less able than grown-up people to resist cold and sudden changes, hence great care must be taken as to their clothing. The legs and chests of children should not be exposed to the bitter blasts of winter nor to the cold winds of spring. Hundreds of children die every year from diseases due to ignorance or neglect in this matter.

Never wear wet or damp clothes one moment longer than possible. Little harm results from wearing wet clothes, provided the person keeps actively moving about while they are drying on him. If you have on wet clothes, take the shortest way home, rub down thoroughly, and put on at once dry, warm clothes. Do not let your damp skirts, wet stockings, or shoes dry on you; but always change them at once. Do not wear clothing tight enough to prevent the free movements of the body. See to it that cnildren wear proper outside garments on going out, and that they are taken off on coming indoors. Pupils should not sit in the schoolroom with outside garments on, such as waterproofs, gossamers, cloaks, rubbers, rubber boots, and leggings.

86. Alcohol and the Bodily Heat. — Soon after taking a small quantity of alcohol, there is a feeling of warmth over the surface of the body. The body is not really warmer, but the skin feels warmer. On

Questions. — What care should be observed with young children? What is said of wet and tight clothing?

the contrary, we are really colder, because heat is more rapidly lost from the surface. The skin is warmer after taking alcoholic liquor, because the nerves that regulate the hair-like vessels on the surface, being weakened, lose their grip: hence more blood is sent from the inner parts of the body to the surface. There is no real increase of heat; the surface is warmed for the time, at the expense of the deeper portions of the body. This surface warmth is now rapidly lost, and the general heat of the body is lowered below its natural temperature.

Experience has proved, time and time again, that alcohol lessens our power to endure extremes of heat and cold. Arctic explorers find that exposure to severe cold can be endured far better without alcohol. The people of the coldest regions of Canada will seldom take even a single glass of spirits when exposed to severe cold. Army life is, perhaps, the best possible test. It is the almost universal experience of British army officers who have led their men through the campaigns in the hottest parts of India and Africa, that alcohol, so far from being a help to resist great extremes of heat, acts as a positive injury.

Questions. — What effect does alcohol have on bodily heat? What does experience prove in this matter?

CHAPTER IX.

THE NERVOUS SYSTEM: HOW IT GOVERNS THE BODY.

87. How all Parts of the Body work together for its Good. — We have studied the human body as a kind of living machine. We have examined its various parts, and found each adapted, not only to take care of itself, but to do some special work essential to the well-being of the whole. Everywhere organs are working together for the common good. Strike suddenly at the eye, and the lids shut to protect it. Tickle the foot, and the muscles of the leg pull it away.

Fifty skilled mechanics might do their best at building a house; but, if each worked as he pleased, the result of their work would be of little value. The master-builder must be at his post, skilful to direct, and quick to act. So with our bodies; and the wonderful agency which governs every part of our bodies is the **nervous system.** Let us learn a few

Questions. — Explain how all the organs of the body work together for the common good of all. What is the wonderful agency called that governs all this?

things about its several parts, *the brain*, *the spinal cord*, and *the nerves*.

88. The Brain. — The **brain** is one of the most wonderful and important organs in the body. It fills

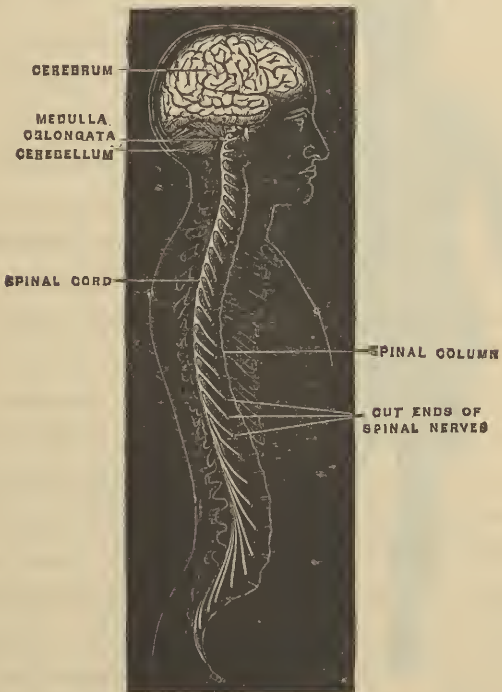

FIG. 44. — Diagram of Brain and Spinal Cord.

the inside of the skull, and is a curious, pulpy-looking mass, not unlike blanc-mange. The outer surface is grooved into folds something like the appearance of

Questions. — Name the several parts of the nervous system. Name the two parts of the brain, as shown by this cut.

a crumpled silk handkerchief. The brain consists of two parts, — one large, the other small. The upper portion, or brain proper, is nearly seven-eighths of the whole mass. It is in halves, one on each side, separated from each other by a deep groove. The little brain lies beneath the back part of the brain proper.

FIG. 45. — Diagram of the Brain, Spinal Marrow, and Nerves, from behind.

How much do you suppose the brain weighs? Well, about three pounds. As a rule, a large brain is the sign of a superior mind. Daniel Webster's brain weighed fifty-three and a half ounces. Agassiz's weighed the same. That of Cuvier, the celebrated naturalist, weighed sixty-four ounces and a third. An idiot's brain rarely exceeds thirty ounces.

Questions. — Describe each part of the brain. What is the weight of an ordinary brain? What is said of large brains?

89. The Nerves. — Now, our backbone, or spine, has inside of it a large nerve, about two feet long, of a whitish gray color, called the **spinal cord.** This goes from the brain down the back of the neck; and all along it gives out little white, glistening threads, called **spinal nerves** (Fig. 45). These come off in pairs from the spine, one to each side of the body; sending out many other branches as they go. These nerve branches go to the muscles, to the organs, to the skin, and to the tissues generally. In fact, every part of the body you could touch has nerves in it.

If you could follow a nerve along its course, you would find, by and by, that you trace it into either the spinal cord or the brain itself, — most likely into the cord, for the greater number of the nerves of the body branch out from it.

Now, messages pass along these nerves *from* the brain, and also back *to* it. It is in the brain that we feel and will. No part of the body has in itself any feeling, or any power of willing its own movement. If all the nerves leading from your hand to the brain were cut across, you would not feel any pain in your hand, nor could you move it at all.

90. The Telegraph System in our Bodies. — The nervous system is like a complete telegraphic system. The brain is the main office; and the thou-

Question. — What is the spinal cord, and what is its use?

sands of nerve fibres, branching off to all parts of the body, are the telegraph-wires. Despatches are constantly being sent to the brain, to tell what is going on in various parts of the body. The brain, on receiving the news, at once sends back its orders

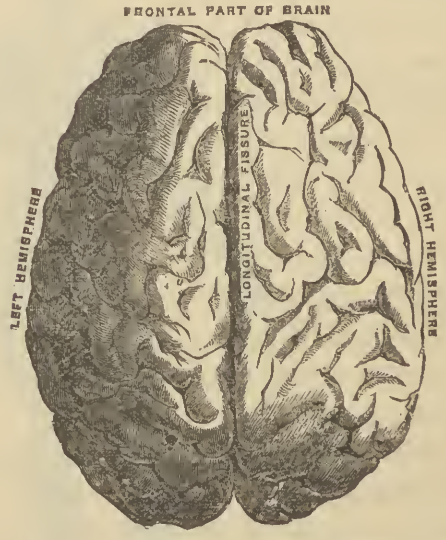

FIG. 46. — Upper Surface of Brain, showing the Convolutions and its Double Structure.

as to what must be done; and the order flies through the nerves faster than it is possible for us to think.

Thus, if you put your hand accidentally on a hot stove, you would not be long in pulling it away. Yet really this is what happened: a message flashed along

Questions. — What may the nervous system be compared to? Illustrate.

the nerves from your hand, through the spinal cord, to the brain, "We are burnt!" The brain at once returned the message to the muscles, "Pull the hand away!" Then the muscles contracted, and the hand was removed.

91. What is meant by Reflex Action. — Now, every message from various parts of the body does not travel as far as the main office, — that is, to the brain, — but some of them are switched off, or "reflected" as we call it, at some of the little offices on the way. These way-stations, located along the spinal cord, receive messages, and send back answers, without consulting the brain. If some one should tickle our toes when we were fast asleep, we would draw our feet away; and yet we would know nothing about it when we awoke.

In eating, we sometimes get a crumb into the windpipe, and cough hard to get rid of it. We cannot help coughing: it goes on without our will. This is called a "reflex action." The impressions made by the tickling and the crumb do not go to the brain; but the signal of danger or distress is sent to one of the way-stations in the cord, and the order to do something is sent back, or "reflected," to the muscles which control the part in need of help.

92. The Importance of Reflex Action. — Did you ever think how important reflex action is to our

Question. — Tell what is meant by reflex action.

health, comfort, and safety? Ten thousand acts take place which tend to keep us well, and yet we have as little control over them as over the stars above us. If the feet slip, the body tends to recover itself without the effort of the will. We try to brush the flies away when we are asleep.

The story is told of an old soldier who, while carrying a bowl of soup across the street, suddenly dropped it on hearing some wag call "Attention!" so used was he, at that word of command, to stand erect, with his hands at his side. By an effort of the will, we can stop our breath for a moment or two; but soon the call for air must be obeyed, whether we will or not. The great work of digestion is going on all our lives, and we have no control over its complicated movements.

What is the good of all this? Why, all the good in the world. By this wonderful provision, our brain is relieved of a vast amount of work. If we were forced to use our will-power to digest our food, the brain would be put to a constant strain We could not, as now, eat and then go about our business. If we had to plan and will every heart-beat, we should soon be tired of life. We could never sleep; for the brain would be on the watch to decide if it were time for the next heart-beat, the next breath, and the proper time for each digestive fluid to flow.

Question. — Explain the importance of reflex action.

93. The Health of the Nervous System. — The health of the nervous system is woven into the welfare of every organ in the body, just as colored threads are woven through a piece of cloth. An

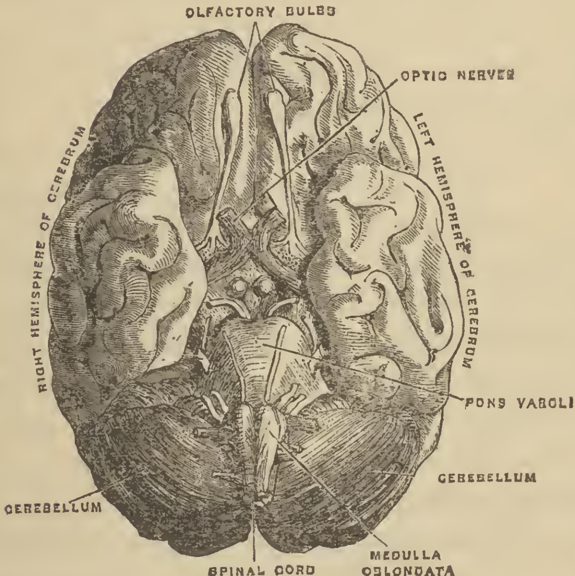

FIG. 47. — Base of Brain

injury to one part affects another part, through the shock to the nervous system. A blow on the head often causes vomiting. An overloaded stomach may make the brain dull and stupid for several hours. Ill digestion may make us at times cross and peevish. Let a small artery inside the skull be broken by a

Question. — What is said of the health of the nervous system?

fall or a blow, and a clot no larger than a bean may be formed, which presses on the brain; and complete loss of motion on one side may result. An accidental blow on the head gave a European ruler, a man of limited intellect, ever afterwards a wonderful memory. It is not an uncommon thing for a person to fall and strike his head, and thus produce a fatal disease of the kidneys.

The brain, or the thinking-part, is a most precious gift. It needs exercise, as well as any other organ. As its office is to think, we should give it good things to think about, just as we give the stomach good food to digest. How necessary it is to keep it sound and healthy! We should bring the brain into the habit of thinking in earnest, so that it may grow strong and vigorous. A gentleman once asked a boy who was idling about the fields, "What are you thinking about?" — "Mostly nought, sir," said the boy; and so it would be with many young people if they were left to themselves, and not taught from their infancy to think.

The little brain of a child should be trained to all that is true, noble, and good. Children should be encouraged to find out all they can about flowers, birds, trees, and animals, and to learn all about this beautiful world. We must learn to use our reason

Question. — Why is it necessary to keep the brain sound and healthy? What encouragement should be given children?

and judgment in all that we do. Self-indulgence should be the last object we have in mind. Self-control is one of the greatest victories we can gain in life, and it will help us to many more. Unhealthy and evil habits are steady drains upon the limited amount of nervous force that each one has. All forms of sensual gratification that excite pleasure, only to be followed by depression, cause a great waste of nervous energy, and tend to sap the very foundation of health and happiness.

94. **Sleep, and how to get it.** — Of all the wonderful things about us which we do not wonder at because they are so common, sleep is one of the strangest. How it comes, why it comes, how it does its kind, helpful work, not even the wisest people are able to tell. We do not have much trouble in seeking it: it comes to us of itself. It takes us in its kindly arms, quiets and comforts us, repairs and refreshes us, and turns us out in the morning quite like new people.

Sleep is necessary to life and health. We crave it as urgently as we do food or drink. In our waking hours, rest is obtained only at short intervals; the muscles and nerves, and the brain, are in full activity. Repair goes on every moment, whether we are awake or asleep; but during the waking-hours

Question. — What is said of sleep? Explain why sleep is so necessary to health.

the waste of the tissues is far ahead of the repair, while during sleep the repair exceeds the waste. Hence good mother Nature at regular intervals causes all parts of the bodily machinery to be run at their lowest rate; in other words, we are put to sleep.

FIG. 48. — Cross-Section of the Left Half of the Brain.

Sleep is more or less sound, according to circumstances. Fatigue, if not too great, aids it; while idleness lessens it. Some kinds of food, as tea and coffee, may prevent it. Anxious thought, and pain, and even anticipated pleasure, may keep us awake: hence we should not go to bed with the brain excited or too

Question. — What is necessary to secure healthful and refreshing sleep?

active. Read some pleasant book, laugh, talk, sing, or take a brisk walk, or otherwise rest for half an hour before going to bed.

The best time for sleep is during the silence and darkness of night. People who have to work nights, and to sleep during the day, have a strained and wearied look. The amount of sleep depends upon the temperament of each individual. Some require little sleep, while others need a great deal. Eight hours of sleep for an adult, and from ten to twelve hours for children and old pople, is about the average amount required. Frederick the Great and Napoleon were light sleepers, four hours daily being the usual time given to sleep by these tireless warriors. Most of the world's great workers have recognized the necessity of a goodly amount of sleep. Sir Walter Scott, the great master of fiction, took much exercise, and always insisted upon having eight hours of sound sleep every night.

Children naturally need more sleep than grown-up people, because their bodies require more rest during the period of growth: hence children should be put to bed early, and sleep in the morning until they awake. Children should not play too hard during the hour before bed-time; but the time should be spent in quiet and restful talk, avoiding startling

Question. — What is the best time for sleep, and what amount is necessary? What is said of the sleep that children require?

stories. When fairly awake, we should get up. Dozing, neither asleep nor awake, is not healthful, especially for young people. The Duke of Wellington used to say, "When it is time to turn over, it is time to turn out."

95. **Effect of Alcohol on the Nervous System.** — The brain and the nerves are very sensitive to the action of alcohol. The first thing we notice is the quickened action of the heart, and with it the dilation of the blood-vessels. The face is flushed, and there is a warm glow all over the body. This is caused by a loss of power in the nerves which control the flow of the blood through its vessels. The tiny vessels of the brain are over-charged: it thus becomes more active, thoughts flow more rapidly, and the speech becomes more fluent.

If still more alcohol is taken, those functions which are under the direct control of the spinal cord become disturbed. The power over some of the muscles is lost. The muscles of the lower lip and of the legs are the first to feel this lack of control. The speech is thick, and the gait uncertain. Reason is off duty, and the lower or animal impulses begin to manifest themselves. The control of the judgment and of the will is lost; and the emotional, the impulsive, and the purely instinctive parts of our

Question. — Explain the effects of alcohol on the nervous system.

nature act without a master. Many and many a success in life has been lost, because he who should have been the man of the hour was unfit for duty by woful drunkenness.

In the last stage of all, the paralysis of the nerve centres and of the brain is carried to its full extent. All the inlets of the senses are closed, consciousness and sensation are lost, and control of the voluntary movements is gone.

96. The Final Result of Alcoholic Excess. — Indulgence in alcohol steadily weakens the self-control of its hapless victim, and at last makes him an utter slave to its lower nature. The most brutal crimes are often committed while a person is crazed with strong drink. The craving for ardent spirits becomes well-nigh irresistible. Self-respect, honor, conscience, common decency, — every thing is sacrificed to get fresh fuel for the alcoholic fire which is burning up its victim.

The disease known as *delirium tremens*, meaning "a trembling madness," is a terrible example of the profound effect which alcoholic excess may have over the nervous system. It is marked by muscular tremors, persistent wakefulness, muttering talk, wild delirium, and all the horrors of hideous delusions

Questions. — What are the last stages of the effects of alcohol on the nervous system? Name some of the final results of alcoholic excess.

which the imagination can possibly conceive. These extreme instances of the breaking-up of the nervous system are found in "homes for the intemperate" and in our insane-asylums, — men and women who have lost every better trace of humanity, hopeless, helpless, doomed to a living death until they cease to live.

97. **The Inherited Craving for Alcohol.** — The craving for alcohol may be inherited by its victim's innocent children, just as we inherit mental and physical vigor or weakness, our features, and even our moral traits. The inherited curse for strong drink has caused many a family to "run out," and leave the children and grandchildren pitiable wrecks of humanity.

98. **The Use of Tobacco.** — The enormous use of **tobacco** is well known, whether smoked, chewed, or used as snuff. However used, it is a narcotic and a poison. Its injurious effects are due to its "nicotine," which is one of the most rapidly fatal poisons known, rivalling prussic acid in this respect. It takes about one minute for a single drop of nicotine to kill a full-grown cat, and it has killed a rabbit in three minutes. The application of tobacco to chafed surfaces, and even to the healthy skin, occasions severe and sometimes fatal results. A tea made of tobacco and applied to the skin has caused death in

Questions. — Show how the craving for alcohol may be inherited. What is said of the use of tobacco?

three hours. Soldiers have been known to shirk military duty by making themselves sick with a leaf of tobacco put under the arm or over the stomach.

The injury done by tobacco varies with its moderate or its excessive use. Even in moderate use it is hurtful, especially to young persons. It certainly does no good, and the tobacco habit once acquired leads to its excessive use. The fact that the habit is foolish, costly, and ill becoming, needs no physiological proof.

99. **The Excessive Use of Tobacco.** — The excessive use of tobacco produces palpitation of the heart, certain forms of dyspepsia, irritation of the throat and lungs, and a general breaking-up of the nervous system. Sometimes, after long smoking, a feeling of dizziness, with a brief loss of consciousness, is produced. At other times, if walking, there is a sense of falling forward, or as if the feet were sinking into cotton-wool.

The excessive use of tobacco may injure the brain. Ideas lack clearness of outline. The will-power is weakened, till it is an effort to do the routine duties of every-day life. The old tobacco-user is often cross, irritable, and liable to outbursts of passion. The memory is also often impaired: the nicotine deadens the delicate nerve-tissue, and hinders its nutrition.

Questions. — Why should young persons avoid contracting this habit? What will its excessive use lead to?

100. Effect of Tobacco upon Young People. — Tobacco in any form has a peculiarly injurious effect upon young and growing persons.[1] It seriously impairs muscular growth and mental activity. The profound effect it has upon the nervous system after the first trial of smoking or chewing is well known. Even after the system gets used to tobacco, young people continue to suffer from nausea, dizziness, headache, muscular trembling, loss of appetite, and general weakness. No boy can continue the practice of smoking or chewing without becoming physically or mentally injured by the time he is twenty-one. No young person should learn to smoke, especially if he wishes to keep strong and vigorous, or is ambitious to succeed in life.

The use of *cigarettes* by young persons cannot be too severely condemned. These are made of the cheapest materials, which are often adulterated with refuse substances, and even with opium. Cigarettes are so common and so cheap that their use to an injurious extent by thousands of young people is really a matter of great practical importance.

Questions. — Tell some of the effects of the use of tobacco by young people. What does Dr. McSherry say on this point? In what form should it especially be avoided?

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[1] "Accumulated facts go to show that growing boys are the worse, mentally and physically, for the use of tobacco. It is a subject not open to discussion." — RICHARD McSHERRY, M.D.

101. **Opium.** — **Opium,** the most valuable of all medicines, is the dried juice of the white poppy. It has the wonderful power of relieving pain, and producing sleep, and is thus indispensable to the physician. Morphine is a white powder made from opium. A solution of opium in alcohol is called laudanum. Paregoric is a weak form of opium combined with other things. Various forms of opium are generally used in liniments, cough-killers, soothing-sirups, stomach-bitters, cholera-mixtures, and countless other preparations which people are eager to buy, hoping for relief from some real or fancied disease.

Opium may be at once a blessing and a curse to mankind. Used with skill by a physician, it does wonders in relieving suffering. Eaten or smoked habitually, to gratify a craving, it makes a living death for its victim. A person may begin in the most innocent way to use opium to relieve pain; little by little the meshes of this fascinating narcotic are woven about him. A person cannot leave off its use without the greatest effort. A craving is created, which no one can realize unless he has once felt the fascination of this wonderful drug. To quit it is untold misery: to continue it is certain death.

Questions. — What is opium? morphine? laudanum? In what preparations do we find opium in one form or another? Describe the opium habit.

Opium completely changes its victim. A man once upright and honest will lie, cheat, or commit any crime, to get a dose of the fatal drug. Promises and resolutions to stop its use may be sincerely made, but are no more binding than ropes of sand. The deepest melancholy settles on the opium-eater; and life, once full of joy and happiness, is indeed a heavy burden.

Opium-eaters often take enormous quantities. De Quincey, the famous author and opium-eater, brought himself to drink more than half a pint of laudanum a day. About twenty drops is the ordinary dose.

102. **Practical Points about Opium.** — The utmost care should be taken in giving infants and children any of the so-called soothing-sirups, cough-killers, and cholera-mixtures. However soothing the effect may be, the child is simply drugged, and not cured. The practice of giving any opiates for summer complaints, and other household ways of using opium, should be sparingly and very cautiously resorted to.

Children as a rule, and many grown-up people too, are very susceptible to the action of opium. Young boys have been made stupid, and their health seriously endangered, by smoking in excess cigarettes that have been drugged with opium. Above all things, do not give to others, especially to chil-

Questions. — What change does the use of opium effect in its victim's character? Give some practical points about opium.

dren, any opium mixture that has been prescribed for some one else. It is a safe rule to avoid every thing that has opium in it unless ordered by the family physician.

103. **Chloral.** — **Chloral** is a powerful drug, capable of producing sleep. Because it is known to induce sleep, especially in those who suffer from excessive mental strain, from anxiety, or other like cause, it has come of late years to be often used without a physician's advice. Like all narcotics, the dose must be steadily increased to get the required effect. The "chloral habit" is soon formed, and the person becomes a slave to a dangerous drug. Without it the chloral-taker cannot sleep: with it his digestion is sadly out of order. He suffers from dyspepsia, shortness of breath, and palpitation of the heart. The habit begets carelessness in its use, and the fatal dose is so uncertain that chloral-takers often die from an over-dose. The only safe rule is, never to touch so dangerous a drug unless prescribed by a skilful physician.

Questions. — What is chloral, and what are its effects? What is the only safe rule to be observed in taking any of these narcotics?

CHAPTER X.

THE SPECIAL SENSES.

104. **The Five Gateways of Knowledge.** — Some nerves, as we have learned, control the action of the muscles; others carry a variety of impressions from every part of the body to the brain. When the brain receives a distinct impression through certain nerves, we become conscious of a **sensation.** Exactly how it occurs is one of the many mysteries of our bodily life. Most sensations are produced by something outside of us. Thus, if we hear a child cry or a bird sing, we have a sensation of sound; if we put sugar on the tongue, hold a rose to the nose, or prick the skin, certain organs receive the impressions, then faithful nerves carry them to the brain, and we become conscious of these different sensations.

There are five "gateways" through which the brain learns what takes place in the outer world; in other words, we have five special senses, — **touch, taste, smell, hearing,** and **sight.**

Questions. — What is sensation? Illustrate. Name the five special senses.

105. **Touch.** — **Touch,** the simplest of the senses, is given to some extent to the whole body; but it is more delicate in the hands and fingers than elsewhere. When we pass our fingers over an object, we say we have felt it, and can tell if it is soft or hard, rough or smooth. If we look carefully at the palm of the hand or at the inner surface of the finger or thumb, we see it is grooved in tiny furrows (Fig. 43). At the tips of the fingers these furrows form circles, growing larger and larger. If the finger-tips be smeared with ink, an impression can be made on paper, showing these widening circles. In these furrows are the nerves, which are exquisitely sensitive. In old times, before the art of writing, and therefore of signing one's name, was common, the old English kings, to sign a document, would ink the end of the thumb, and stamp it on the paper: hence the phrase, "my *hand* and seal."

This sense can be cultivated to a marvellous extent. Think what blind people can do! They read rapidly by running their fingers over slightly raised letters, and recognize their friends by feeling their faces. Watch an expert pianist, and see the skill and the precision with which he handles many keys in a few seconds of time.

106. **Taste.** — The tongue is the principal organ of

Questions. — Where does the sense of touch reside? Where are the nerves? Show how this sense may be highly cultivated.

taste (Fig. 49). It has two coverings, — an outer layer, and a deep, sensitive layer. In some diseases this outer layer becomes coated with a whitish or yellowish matter. The deep layer is raised up, like the true skin, into tiny hillocks, or *papillæ*, which are abundantly supplied with delicate nerves, — the nerves of taste. The tip and back of the tongue are supplied with different nerves. Hence it makes a difference whether we put a substance to be tasted, on the tip or back of the tongue. Thus alum tastes acid on the tip, and has a sweetish taste on the back part of the tongue. In certain animals these papillæ are very large, and give a roughness to the tongue. We know how rough a cat's tongue is. It is this which enables the cat to strip off the flesh from a bone by simply licking it, while the lion strips the skin from his victim with one stroke of his tongue.

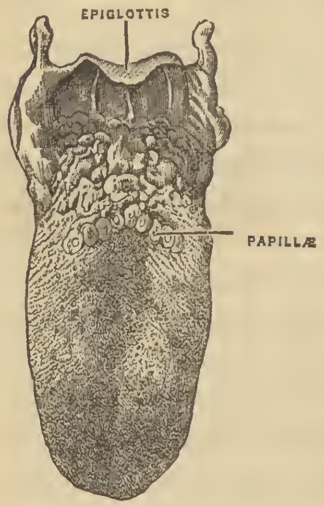

Fig. 49. — Upper Surface of the Tongue showing the Papillæ.

Taste is very much a matter of custom. The Lap-

Questions. — In what organ does the sense of taste principally reside? Describe the tongue.

landers drink rancid fish-oil with a relish; the Persians used as an appetizer the offensive assafœtida, which they called the divine perfume; and the Chinese season their salad with castor-oil. Great acuteness may be gained in the sense of taste. The skill of the "tea-tasters" is something wonderful.

Fig. 50. — How the Papillæ of the Tongue look under the Microscope.

107. Smell. — The seat of the sense of **smell** is in the cavities of the nose, into which the nostrils open, and which connect behind with the back part of the mouth, The walls of the nasal cavities are lined with a thick, velvety membrane, over which the nerves of smell are distributed. This membrane is kept continually moist by a fluid which it secretes. At the beginning of a cold in the head, this membrane becomes dry and swollen, and the sense of smell is lessened. In the roof of the nasal cavities the sense of smell is most acute: hence, when we wish to detect a faint odor, we sniff up the air.

The sense of smell varies very much in different individuals; in some persons it is very dull, while

Questions. — Where does the sense of smell reside? Describe the nose.

others have a very "sharp nose." In savage races this sense is most acute. We are told that the South-American Indians can by their sense of smell detect the approach of a stranger, even in a dark night, and can also distinguish whether he is white or black. Many animals are more highly endowed

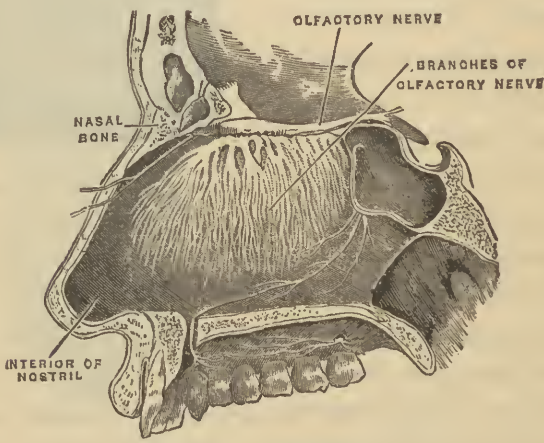

FIG. 51.—The Organ of Smell.

with this sense than man. A dog will smell the footsteps of his master amid those of a hundred other people, and can trace him for miles, although he has been for hours out of sight. Pointers also scent game at a great distance.

The sense of smell is nature's sentinel to guard

Questions.—How does this sense vary in different individuals? What protection does it afford?

against taking improper food into the stomach, and impure air into the lungs.

109. **Hearing.** — Next to sight, **hearing** is the most important of the senses. We could get along without being able to taste; but without seeing and hearing, life would be almost a blank. Our ears have their delicate structure securely lodged in the "temple" bones. The *outer ear* is a piece of gristle covered with skin, and curiously moulded for catching sounds. In animals it is quite movable; hence the timid rabbit and the intelligent horse "prick up their ears" to listen. The tube in the ear is about an inch long, and guides the sound in just as an ear-trumpet does. At the lower end of this passage we find a delicate membrane stretched across, which serves as a partition between the outer and the middle ear. It is thin and elastic, hence easily broken by a blow, or by pushing any thing into the ear. If once broken or destroyed, the hearing is impaired.

The *middle ear* is really the "drum," and in form resembles an ordinary drum. Three of the tiniest bones in the body stretch across it. They are so small that you can easily balance them on the tip of your finger. One curious thing is, that they are as large in infancy as they ever will be. The air reaches the inside of our "ear-drum" through a little tube

Questions. — Which is the most important of all the senses? Where does this sense reside? Describe the outer ear.

about an inch long, which leads into it from the throat. It serves to keep the air on both sides of the drum at a constant and even pressure. Hence gunners open their mouths when a heavy cannon is about to be fired, so that the shock may be felt less forcibly. In going up a high mountain or down in a diving-bell, people swallow repeatedly, to save the feeling of discomfort and pain in the ears.

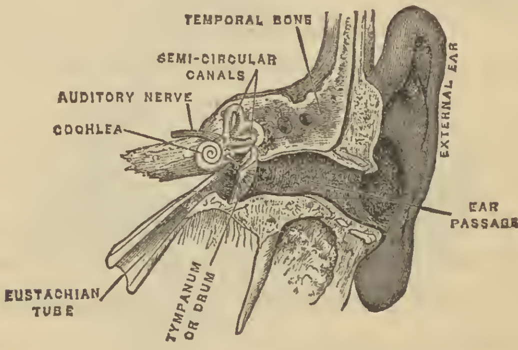

FIG. 52. — Sectional View of the Ear.

The *inner ear* is one of the most delicate and complex pieces of mechanism in the whole body. It is really a bony case of the tiniest winding chambers and spiral tubes hollowed out in the solid bone. These little passages are lined with a delicate bag of membrane of exactly the same shape as themselves. The nerve of hearing passes from the brain, through a little hole in the skull, to the inner ear, and is

Question. — Describe the middle ear; the inner ear.

spread out on this lining. The impression thus perceived is carried to the brain, where it gives rise to the sensation of hearing.

109. **Care of the Ear.** — The ear is a very delicate organ. It is often carelessly and ignorantly tampered with. It is often neglected when skilled treatment is urgently needed. The ear-canal should never be rudely or hastily washed out, but the utmost gentleness used in cleansing it.

Children's ears should never be pulled or boxed, for even a slight blow has resulted in deafness. Never use ear-picks, ear-spoons, the end of pencils or pen-holders, pins, hair-pins, tooth-picks, etc., to pick or scratch the ear-canal. It is a foolish, needless, and dangerous practice.

Cotton wads may be gently put into the ears to shield them from the cold, or they may be worn in swimming or diving to keep the water out. Diving in deep water, or bathing in the breakers, often injures the ears. If flies, bugs, ants, and the like crawl into the ears, this may cause some pain and fright, and perhaps lead to vomiting and even convulsions. The ear may then be syringed out with a little warm soap-suds, or drop in a few drops of molasses or sweet-oil. Cold water should never be put into the ears, but only tepid water. Do not go to

Question. — What care should be observed with the ear, and why?

sleep with the head in any position that may expose the ears to a draught of cold or damp air.

110. Sight. — **Sight,** or vision, when we think about it, is a wonderful thing. That we have a means by which we can learn what is going on in the outside world, miles away from us, is a precious gift. We watch a huge balloon from the time it leaves the ground till it is a black speck in the air above us. We watch a vessel sailing along on the dim horizon, and the next instant we are reading the fine print of a newspaper. We are able to recognize the form, size, color, and distance of thousands of different objects in nature. This sense is so woven into the countless acts of our every-day affairs, that we scarcely appreciate this marvellous gift, so essential not only to the simplest matters of comfort, but also to the culture of the mind, and the higher forms of pleasure. Sight is well held to be the highest and most perfect of all the senses.

111. The Eye. — The eye, a most beautiful and ingeniously contrived organ, is the instrument of sight. It is really one of the greatest wonders in nature. All the seeing parts of the eye are held in an egg-shaped bag lodged in a cavity of the skull. It is well protected by the strong bones of the head. Passing to the brain, through a crevice in the bot-

Questions. — What is said of the sense of sight? How is this wonderful organ of sight protected from injury?

tom of the eavity, is the optic nerve, which gives the power of sight. It spreads itself like a network upon the inner surface of the eyeball, and is then called the retina. It is upon this that the pictures of all objects are thrown. The impression of the pictures is carried to the brain, and causes the sensation of sight. We must rememher that it is not

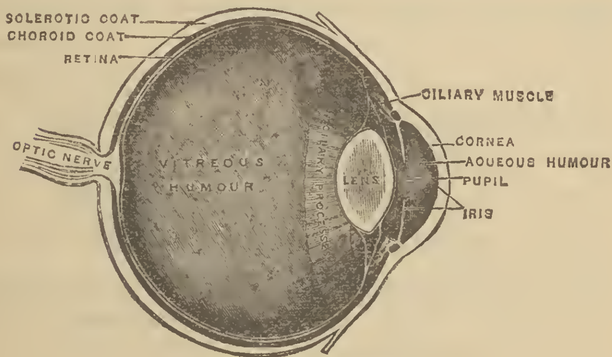

Fig. 53. — Section of Eyeball.

the eye that sees, but the mind behind it; it is not the ear that hears, but the mind through the ear. This network also takes in the most delieate shades of color; and, by the action of the nerves of both eyes at the same time, we get the idea of the shape of objeets, and of their distance from eaeh other. Sometimes the optie nerve is diseased, and total blindness results. The great poet John Milton suf-

Questions. — What is the optic nerve, and what office does it perform?

fered from this disease, and in his blindness dictated to his daughters the immortal poem, "Paradise Lost."

The eyeball is a bag almost round, thick and dull everywhere but in front, where it has a transparent covering called the cornea, meaning "a horn." This is fitted into the eye just as a watch-crystal is fitted into a watch. Sometimes it bulges out a trifle too much, and an imperfect picture is made on the retina. Such a person is said to be near-sighted. Through this watch-glass the rays of light pass into the ball of the eye. Behind it is a space, called the front chamber of the eye, filled with a watery fluid. In this chamber hangs a curtain called the iris, meaning "rainbow." It has through its centre a hole called the pupil, poetically called "the apple of the eye." This curtain gives the color to the eye.

Behind the pupil is a transparent, jelly-like body, about the size of a French bean, called the crystalline lens. It separates the front chamber of the eye from the back chamber. This beautiful lens helps the cornea to bring the pictures to a point, or "focus," on the retina. The back chamber also holds a jelly-like fluid, called the "glassy humor," which allows the iris-curtain to float and move freely.

112. How the Eye is protected. — The eye is like a precious gem placed in a carefully prepared

Questions. — Describe the eyeball; the crystalline lens.

case. The eyelids, by continually winking, protect the eye from insects and from dust. They are fringed with the delicate hairs of the eyelashes, which are so sensitive that the slightest touch gives warning, and the lids close. By means of little muscles the eye is moved up and down, and rolled sideways. Sometimes these muscles do not act properly, and a person is said to squint or be cross-eyed.

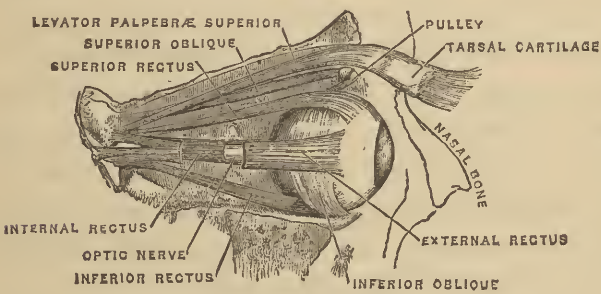

FIG. 54. — Muscles of Eyeball.

At the upper and outer side of each eye is a little gland which is constantly forming a saltish kind of fluid. Sometimes more of this fluid comes out of the little gland than can be carried away through the nose, and it flows over the eyelids down the cheeks, and is called tears. Tears are constantly passing over the front of the eye, washing it clean, and keeping it moist; while the eyelid wipes it dry, as

Questions. — What is the use of the eye-lashes? What are tears, and what is their use?

it were, by forcing the tears into a little drain-pipe, which carries them off into the nose. Nature, however, kindly oils the edges of the eyelids, to prevent, to some extent, the overflow of tears.

113. **Color-Blindness.** — Color-blindness is the inability to tell certain colors. It is sometimes produced by sickness, but generally exists at birth. This defect of sight is quite common. It is found that four or five out of every hundred people are color-blind. A person may be color-blind, and not know it until the defect is accidentally revealed. It is a matter of the utmost practical importance to those employed on railroads, vessels, and other places where colored signals are used. Some are only partially color-blind, while others are wholly so. The most common form of color-blindness is that in which one fails to distinguish red.

114. **Care of the Eyes.** — The eye is an exceedingly delicate and sensitive organ. It is easy to get it out of order, and very tedious to restore it to health. The eyes are often weak after certain sicknesses, especially measles and scarlet-fever. The habit of reading in the cars or a carriage the daily papers, with their blurred and fine print, is a severe strain on the eyes.

It is a dangerous practice to read in bed at night,

Questions. — What is color-blindness? To what class of people is it important to be able to distinguish color readily?

or while lying down in a darkened room. The small type and poor paper of the many cheap "libraries," now so popular, are very frequent causes of weak and diseased eyes. The direction in which the light comes is an important matter. The worst of all is from in front. The direct light should fall upon the print from above and behind, and from the left side. After reading steadily for some time, we should rest the eyes, even for only a minute, by looking at some distant object. A person should never read, write, sew, stitch, or otherwise use the eyes, when they tingle or smart, or the sight is dim or blurred; for they are weary, and need rest. Using the eyes at dusk, or by artificial light in the early morning, often leads to serious disorders of vision.

The eyes should never be rubbed or handled roughly, much less when they are irritated by some foreign substance. The sooner such is removed, the better. Rubbing the eye, or pulling the eyelids, only makes a bad matter worse. It is not a wise economy to tamper with one's eyes when they are ailing. If a few days' rest does not give relief, secure proper medical advice.

115. **Effect of Alcohol and Tobacco on the Special Senses.** — Whatever dulls or weakens the nerves, must exert the same effect upon the special

Question. — Name a few important rules to be observed in the use of our eyes.

senses. Hence alcohol and tobacco dull the senses, and also provoke changes in the sense-organs themselves. Thus alcohol used in excess often injures the ears by inflaming the throat, and then the tube which leads to the middle ear.

Tobacco is apt to cause an inflamed state of the throat and nose, and hence ear-disease. Excessive smokers occasionally suffer from a dimmed vision due to a partial paralysis of the optic nerve. Excessive use of alcohol is said to cause the same disease. Tobacco and alcohol often produce an inflammation of the eyes and of the lining of the lids.

Cigarettes are said to be especially hurtful to the lining of the throat, and the eyes. An atmosphere loaded with tobacco-smoke is apt to provoke an inflammation of the throat, nose, and ears.

Questions. — What is the effect of alcohol on the special senses? of tobacco?

REVIEW ANALYSIS:

STIMULANTS AND NARCOTICS.

1. The Muscles. (Chap. iii. p. 34.)	Effect of Alcohol on the Muscles (**25**).[1]
2. What we eat and drink. (Chap. iv. p. 48.)	1. Artificial Drinks (**33**). 2. Effect of drinking Tea and Coffee (**34**). 3. Alcohol described (**35**). 4. Principal Drinks that contain Alcohol (**36**). 5. Alcohol as a Food (**37**). 6. Alcohol and Work (**38**).
3. How Digestion goes on. (Chap. v. p. 65.)	1. Indigestion due to Alcohol (**51**). 2. Effect of Alcohol on the Stomach Digestion (**52**). 3. Effect of Alcohol on the Liver (**53**).
4. The Blood. (Chap. vi. p. 92.)	1. How Alcohol gets into the Blood (**62**). 2. Effect of Alcohol on the Circulation (**63**). 3. Effect of Alcohol upon the Heart (**64**).
5. How and Why we Breathe. (Chap. vii. p. 106.)	Effect of Alcohol and Tobacco upon the Air-Passages (**75**).
6. How the Body is covered. (Chap. viii. p. 121.)	Alcohol and the Bodily Heat (**86**).
7. The Nervous System. (Chap. ix. p. 138.)	1. Effect of Alcohol on the Nervous System (**95**). 2. Final Result of Alcoholic Excess (**96**). 3. Inherited Craving for Alcohol (**97**). 4. Tobacco and its Moderate Use (**98**). 5. Excessive Use of Tobacco (**99**). 6. Effect of Tobacco upon Young People (**100**). 7. Opium (**101**). 8. Practical Points about Opium (**102**). 9. Chloral (**103**).
8. The Special Senses. (Chap. x. p. 158.)	Effect of Alcohol and Tobacco on the Special Senses (**115**).

[1] The figures in full-face type, in the parentheses, refer to the numbers of the sections in the preceding chapters of this book.

CHAPTER XI.

HINTS AND HELPS FOR EVERY-DAY HEALTH.

116. **Accidents and Emergencies.** — All kinds of accidents and emergencies may happen at any moment. A friend may cut himself with a scythe or a knife; a child may accidentally swallow some poison; a boy may be taken out of the river apparently drowned; one of our own family may be sick with some contagious disease, or may be nearly suffocated with coal-gas. All these, and many other things of a like nature, call for a cool head, a steady hand, and some practical knowledge of the best thing to do "till the doctor comes."

117. **Fainting.** — A fainting person should be laid flat at once, with the head very low. Give plenty of fresh air; and dash cold water, if necessary, on the head and neck. Loosen all tight clothing.

Collateral Reading. — Hope's *Till the Doctor comes;* Dulles's *What to do first in Emergencies;* Turner's *Common Accidents and Diseases;* Dixon's *What is to be Done: An Emergency Handbook;* Tracy's *Handbook of Sanitary Information.*

Questions. — Name some accidents that are liable to occur at any moment. What is required at such times?

118. **Frostbite.** — The ears, toes, nose, and fingers are occasionally frostbitten or frozen. Rub the frozen parts gently with snow or snow-water, in a cold room. The circulation should be restored very slowly. Hot milk with cayenne pepper, and hot strong coffee, should be freely given as stimulants.

119. **Fits, Convulsions.** — A sufferer from "fits" should be treated much the same as for fainting. There is foaming at the mouth, the eyes are rolled up, and the tongue or lips are often bitten. See that the person does not injure himself; crowd a folded handkerchief between the teeth, to prevent biting the lips or tongue. Persons who are subject to such fits should not go into crowded or excited gatherings of any kind.

120. **Suffocation.** — The chief dangers from poisoning by noxious gases come from the fumes of burning coal in the furnace, stove, or range; from gas blown out by a draught; from the foul air often found in old wells; and from the fumes of charcoal and the foul air of mines.

The first thing to do is to give fresh air. Remove the person to the open air, loosen all tight clothing, dash on cold water, and, if necessary, use artificial respiration, as stated in the section on "Drowning."

Questions. — What should be done for a person fainting? What is the treatment for frost-bites? for fits or convulsions? for suffocation?

121. **Broken Bones.** — Send for a surgeon at once. Loss of power, pain, and swelling are symptoms of a broken bone, that may be easily recognized.

Broken limbs should always be handled with great care and tenderness. If the accident happens in the woods, the limb should be bound to a piece of board or bark, padded with moss or grass, which will do well enough for a splint until the patient reaches home.

122. **Sting of Insects.** — If a piece of the sting remains in the wound, extract it with the fingers or with a pair of tweezers. The best application is diluted ammonia-water, after which a cloth wet with sweet-oil should be placed upon the part.

123. **Nosebleed.** — Slight nosebleed requires little treatment. Keep the head erect, place a basin under the chin for the blood to run into, and then the patient should take several deep inspirations, filling the chest fully at each breath. In most cases this will soon stop the bleeding. Ice may be applied to the nose.

124. **Foreign Bodies in the Nose.** — Children are apt to push marbles, beans, peas, fruit-stones, buttons, and other small objects, into the nose. Sometimes we can get the child to help by blowing his nose hard. At other times a sharp blow between

Questions. — What should be done for broken bones? for the sting of insects? for nosebleed?

the shoulders will cause the substance to fall out. Stop the well nostril, and blow suddenly and forcibly through the mouth. Call in medical help at once if you do not meet with success, especially if it is a pea or bean, which is apt to swell with the warmth and moisture.

125. **Foreign Bodies in the Ear.** — The simplest thing to do is to syringe in a little warm water, which will often wash out the substance. If insects crawl into the ear, drop in a little sweet-oil or molasses. If the tip of the ear is pulled up gently, the liquid will flow in more readily.

126. **Foreign Bodies in the Throat.** — Bits of food and other small objects sometimes get lodged in the throat, and are easily got out by the forefinger or by sharp slaps on the back. If it is a sliver from a toothpick, a match, or a fish-bone, it is no easy matter to remove it; for it generally sticks into the lining of the passage. If the object has actually passed into the windpipe, and then occur sudden fits of spasmodic coughing, with a dusky hue to the face and fingers, there is great danger of life: surgical help must be called without delay.

If a foreign body, like coins, pencils, keys, fruit-stones, etc., is swallowed, it is not wise to give physic. Let the bowels alone, and give plenty of

Questions. — What should be done for foreign bodies in the nose? for foreign bodies in the ears? for foreign bodies in the throat?

hard-boiled eggs, cheese, and butter-crackers, so that the substance may be passed off in the natural way, in a bulky stool.

127. **Foreign Bodies in the Eye.** — Cinders, particles of dust, and other small substances, often get into the eye, and cause much pain. Do not rub the eye: it will only make bad matters worse. Often a copious flow of tears will wash the substance away: it is sometimes removed with the twisted corner of a handkerchief carefully used. If it is not removed, or if not found, in this way, the upper lid must be turned back. This requires skilled help.

128. **Sunstroke or Heatstroke.** — The worst cases of "sunstroke" often happen in places where the sun's rays never penetrate. There is sudden loss of consciousness, with deep, labored breathing, an intense, burning heat of the skin, and a marked absence of sweat. The main thing is to lower the temperature. Strip off the clothing. Apply to the head chopped ice wrapped in flannel. Rub ice over the chest, and place pieces under the arm-pits and at the sides. If there is no ice, use cloths wet with cold water. The body may be stripped, and sprinkled with ice-water from a common watering-pot. Persons who have once suffered from sunstroke should avoid any risk in the future.

Questions. — What should be done for foreign bodies in the eye? for sunstroke or heatstroke?

129. **Burns or Scalds.** — Remove the clothing with the greatest care. Do not pull, but carefully cut and coax, the clothes away from the burned places. Save the skin unbroken if possible, taking care not to break the blisters. The secret of treatment is to avoid chafing, and to keep out the air. Baking-soda, used dry or dissolved in water, is a very good household remedy for burns. Another remedy is to soak strips of old linen in a mixture of half linseed-oil and half lime-water. A deep or extensive burn should have prompt medical attendance.

130. **Bruises, Cut and Torn Wounds.** — A bruise is a wound of the soft tissues, caused by blows. A black eye, and a lip or finger hurt by a base-ball, are familiar examples. Soak the injured part at first in cloths wrung out in cold water. Very hot water is often used to relieve the pain. If the cuts are small, clean the parts, bring the edges together, and stick them with plaster. When wounds are made with ragged edges, such as those made by broken glass, splinters, toy pistols, and rusty nails, more skill is called for. Such wounds, if neglected, often lead to serious results from blood-poisoning. The services of a doctor are generally necessary.

131. **Bleeding.** — It is very important to know the difference between bleeding from an artery and that

Questions. — What should be done for burns or scalds? for bruises, cut or torn wounds?

from a vein. If an artery bleeds, the blood is of a bright-scarlet color, and spurts in a stream. If a vein bleeds, the blood is of a dark and purple color, and slowly oozes out, or flows in a steady stream. Bleeding from an artery is a dangerous matter in proportion to the size of the vessel, and life itself may be speedily lost; while bleeding from a vein is rarely a serious injury, and generally stops of itself, aided, if need be, by pressure. When an artery is bleeding, always remember to *make deep pressure between the wound and the heart.* Send at once for the doctor.

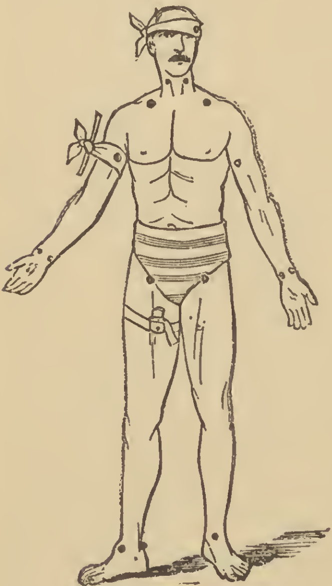

FIG 55.

EXPLANATION — The dots mark the places on which to press when the person is bleeding from an artery wound. In each case the dot marks the nearest place above the wound (on side nearest the heart) upon which pressure can be of use to stop the bleeding.

Meanwhile there is something to do. Keep cool, and do not be afraid to act at once. A firm grip in the right place with the fingers will do, until a twisted handkerchief, stout cord, shoestring, or sus-

Question. — What should be done for bleeding?

pender is ready to take its place. If the artery is of some size, make a knot in whatever is used, and bring the pressure of the knot to bear over the artery. If the flow of blood does not stop, change the pressure until the right spot is found. Strips of an old handkerchief, a bunch of moss, underclothing, or cotton wading, might be stuffed into the wound, keeping up the pressure all the time; or seize a handful of dry earth, and crowd it down into the bleeding wound with a firm pressure.

Let me tell you of the principal places to apply pressure when arteries are injured and bleeding. If in the *finger*, grasp it with the thumb and forefinger, and pinch it firmly on each side; if in the *hand*, press with the thumb just above, and in front of, the wrist. For injuries *below the elbow*, grasp the upper part of the arm with the hands, and squeeze hard. For the *upper arm*, press with the fingers against the inner edge of the biceps muscle. For the *foot* or *leg*, press as before in the hollow behind the knee, just above the calf of the leg.

132. Apparent Drowning. — Remove all tight clothing from the neck, chest, and waist. Sweep the forefinger, covered with a handkerchief or towel, round through the mouth, to free it from froth and mucus. Turn the body on the face, raising it a little, with the hands under the hips, to allow any

Question. — What should be done for apparent drowning?

water to run out from the air-passages. Take only a moment for this. Lay the person flat upon the back, with a folded coat, or pad of any kind, to keep the shoulders raised a little. Remove all the wet, clinging clothing that is convenient. If in a room or sheltered place, strip the body, and wrap it in

FIG. 56.

blankets, overcoats, etc. Use bottles of hot water, if at hand, hot flat-irons, or hot sand, round the limbs and feet.

The main thing to do is to keep up artificial respiration until the natural breathing comes, or till all hope is lost. This is the simplest way to do it: The person is laid on the back. Let some one kneel behind the head. Grasp both arms near the elbows, and sweep them upward above the head until they

nearly touch. Make a firm pull for a moment. This tends to fill the lungs with air by drawing the ribs up, and making the chest cavity larger. Now return the arms to the sides of the body until they press hard against the ribs. This tends to force out the air. This makes, artificially, a complete act of respiration. Repeat this act about fifteen times every minute. All this may be kept up for several hours.

FIG. 57.

When a person can breathe, even a little, he can swallow. Give then hot, strong coffee every few minutes, a teaspoonful at a time, or a little ammonia and water. Meanwhile do not fail to keep up artificial warmth. Do not move a person who is just beginning to breathe again, from one place to another, except when forced to do so from cold or some pressing necessity.

133. The Proper Use of Alcoholic Drinks.— In the hands of a good physician, alcohol, like many other powerful agents, often proves a valuable remedy. In cases of extreme weakness and bodily peril, undoubtedly alcoholic drinks, either alone or combined with other things, as milk, ammonia, etc., serve to bridge over critical moments of disease when other agents would not be tolerated. Upon the doctor rests the responsibility of giving alcohol, as well as such drugs as aconite, arsenic, strychnia, opium, belladonna, and other poisons. It is well to remember that good physicians, as a rule, are slow to prescribe, or even to use, the various forms of alcohol in their professional labors.

Alcohol is the basis of most liniments, and, as such, is a useful agent. People are much inclined to use alcohol and rum in family use for all kinds of outward applications. No doubt, very cold or very hot water would do just as well in most cases. The use of some form of alcoholic liquor for every little ache or pain that occurs in the family, cannot be too severely condemned.

Alcoholic mixtures must be used with the greatest caution, especially if there is any danger of arousing the alcoholic appetite. Use common sense, and act honestly and consistently in this matter of using alcohol as in every other act of life. Black coffee, strong tea, hot water, cold water, hot milk, cayenne

pepper, and ammonia water, in most emergencies, are strong remedies enough to use "till the doctor comes."

134. **The Habit of taking Unknown Medicines.** — The habit of taking medicines, especially of an unknown character, is something alarmingly common. If we have an ache or pain about us, a friend advises this or that medicine because "it did him good," or we are foolish enough to spend our money for some advertised nostrum claiming to have wonderful virtues. All people, especially sensible young persons, should have respect enough for their health to let all unknown medicines alone. Rest assured, if the skilful physician cannot help us, medicines made by some "benefactor of mankind," simply to sell, will do us no good.

135. **Hints for the Sick-Room.** — The sick-room should be the lightest and most pleasant room in the house. Take away all extra carpets, upholstered furniture, heavy curtains, etc.: they absorb the impurities, and help keep the room foul. A clean floor, with a few rugs to deaden the footsteps, is much better than a woollen carpet. Let the room be open to the sunlight and the fresh air. Guard the patient from the noise of passing steam and horse cars, heavy teams, and playing children. With

Questions. — What is said of the habit of taking unknown medicines?

a little pains any sick-room may be supplied with pure air. Do not let the disagreeable odors due to cooking victuals, especially frying fish or pork, cooking cabbage, etc., reach the sick-room. Do not allow a kerosene light, with its flame turned down, to burn through the night.

Keep a sick-room neat and trim. Remove at once all offensive matters. Never allow such to remain in the room. In many diseases, especially scarlet-fever, diphtheria, consumption, etc., use pieces of old linen instead of handkerchiefs, and burn them as soon as used. Carelessness or ignorance in this matter often spreads contagious disease. Change the clothes of the bed and of the patient quite often. Do not let such clothing be put away in a closet with other clothing. Put it to soak at once in boiling water, with some disinfectant added if necessary. Do not have food left in the room. Do not make a great show of bottles of medicines, spoons, glasses, etc., carefully spread out on the bureau or table. Keep all such things in an adjoining room. To a patient not used to sickness, a great show of drugs and sick apparatus is discouraging. Some simple thing like an orange, a few favorite flowers, and one or two playthings, may take their place.

Never get behind the door, in a corner, or in an adjoining room and *whisper*. Whatever must be

Question. — Give some hints about the sick-room.

said, say it openly and aloud. Answer a sick person's questions plainly and squarely. Nothing is gained by trying to avoid a straightforward reply. If a doctor is employed, carry out his orders to the very letter.

136. **Poisons in General.** — Poisons of various kinds are often used in the trades, and kept about the house and premises as medicines, as disinfectants, for killing insects and animals, and for many other purposes. People are often careless about them, and leave them in the cupboard or on a shelf about the shed or stable, wrapped in a piece of paper, or in some unlabelled bottle. Children either mistake them, or are urged by some playmate to swallow them. The many accidents due to drinking carbolic acid by mistake are a familiar example of how stupid or careless people may be.

Poisons should always be carefully labelled, and the word "POISON" plainly printed in large letters across the label. Fasten the cork firmly to the bottle by wire, twisted into a knot at the top. This would certainly prevent a person from mistaking carbolic acid, oxalic acid, etc., in the dark, for medicine. Poisons should never be kept in the same place with medicines or other bottled preparations used in the household. Put them in some secure place, and

Questions. — What can you say about poisons? What about their preservation?

under lock and key. Never use the contents of any package or bottle unless you know exactly what it is. Do not guess at it, or take any chances; but destroy it at once.

Poisons may be taken when medical help, especially in the country, cannot be had at short notice. They do their work rapidly. Something must be done, and that at once and in earnest. The stomach must be emptied as speedily as possible. Make a quart of warm soapsuds. Force the sufferer to gulp it down, a cupful at a time. Run the finger or a feather "down the throat," and hasten the vomiting. A good emetic is made by putting a heaping tablespoonful of ground mustard into a pint of water. Drink a cupful every ten minutes until vomiting is produced. Stir up a handful of powdered alum in a cupful of molasses, and swallow this, a tablespoonful every ten minutes. Vomiting will do no harm, and the poison may destroy life in a few minutes.

The young student is referred to more advanced books than this, for mention of antidotes for particular poisons.

137. **Sicknesses that spread.** — We have learned in a preceding chapter (chap. vii.) that the air may be poisoned by the products of respiration, and by other waste matters thrown off from *healthy* human bodies. The air may be poisoned also by the products of res-

Question. — When is it necessary to use emetics?

piration and bodily discharges of *diseased* persons. Thus, in certain diseases, called *contagious*, there are thrown off in some way from the persons of the sick, organic matters, which tend to reproduce themselves in the bodies of other persons. Small-pox and scarlet-fever are examples of severe and contagious diseases; while whooping-cough, measles, and mumps are contagious, but less harmful.

Again: the air may be poisoned with the foul gases arising from the contents of cesspools, sewers, and other sources. The living particles, or "germs," of such diseases as typhoid-fever and dysentery, are believed to be contained or developed in the discharges both from the stomach and bowels of persons suffering from these diseases. Diphtheria and typhoid-fever are believed to be due oftentimes to the foul contents of cesspools and sewers. Finally, the air may be poisoned by the decay of organic matters in the ground, and drawn into the house in various ways. Thus there seems to be a connection between malarial fever and bad drainage.

138. **Disinfection.** — With our present knowledge, it is not possible to get rid of the germs of disease after they are once lodged in the body. We are able, however, to a certain extent, to destroy them after they leave the body in the excretions of dis-

Question. — Mention the ways in which the air may be poisoned by contagious diseases.

eased persons. This destruction of the poisons of infectious and contagious diseases is called *disinfection*, and the means used are called **disinfectants.** We must remember that disinfection cannot make up for the want of cleanliness or of ventilation. Practical directions for the use of disinfectants are given in the more advanced text-books.

Question. — Tell something about disinfectants and their uses.

CHAPTER XII.

MALARIAL AND TYPHOID FEVERS.[1]

139. **Malarial Fever.** — An old writer has said, that if our bodies were incased in glass, and if we could look therein, and see the workings of our hearts, lungs, and other organs, we would be in hourly dread of doing fatal injury to this delicate and complicated machinery of ours, by our slightest movement.

And yet young people, and old people too, are continually committing some act of folly which renders them liable to disease, and even to death. A little girl, over-tired by rope-jumping or other violent exercise, or a boy fatigued by hard play or too much bicycle, seeks rest by lying on the damp ground in the hot sun, or perhaps in the cool of the late evening.

Questions. — Tell what an old writer has said of our bodies. Explain the danger of resting on the damp ground in the hot sun, or late in the evening.

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[1] This admirable chapter has been especially written for this book by Jackson Piper, M.D., president of the Maryland State Board of Health. The young student will find it worthy of his best study.

A subtle vapor, exhaling from the moist earth, enters the lungs, and is carried thence into the blood and through the entire system. A chill is the result, followed by a hot fever, ending in a profuse and weakening perspiration. For a time the little sufferer is better; but a like chill, fever, and perspiration come the next day, and the next, and so on for weeks, until the disease is checked by bitter quinine or some other nauseous medicine. It does not always stop here, but leaves behind it diseases of the liver and spleen, and a tendency to recur. This disease is called *intermittent fever*, because the fever *intermits;* that is, the sick person is entirely free from fever after the perspiration and until the next chill, when the fever begins again. Other names are malarial fever of the intermittent type, chills and fever, and the ague.

Three things cause it: first, decay of vegetable substances (such as rank weeds, plants, and decaying wood), vegetables allowed to remain too long in the cellar, and slops thrown out on the ground; second, moisture; third, heat. Thus this fever is most prevalent in the summer and autumn. The poison, therefore, consists of vegetable matter, and exists about all damp, moist localities, such as marshy places, wet

Questions. — What is this disease called, and why? By what other names is it known? Name its causes. Where is it most prevalent?

cellars, choked drains, stagnant water about lakes and along rivers. In fact, this fever lurks in any place where plants are allowed to decay in heat and moisture, or where new earth is upturned, as in making railroads, and grading for new houses. This poison has been called at different times by different names, and, latterly, *germs*.

Another form of this fever is called the *remittent malaria*, or bilious fever, because the fever is present all the time, but is higher at one time than at another; that is, it *remits*. This fever depends upon the same causes and influences as the first-mentioned fever, and, while lasting longer, does not recur again, or leave the bad after-effects that follow intermittent fever.

140. **Typhoid Fever.** — The next fever that depends upon a germ, or active principle, is *typhoid-fever*. This germ is generated from animal matter, — most frequently from the discharges of persons sick with the disease. Under putrefying changes or decay, the air is poisoned, or, sinking into the earth, the poison finds its way into our wells and springs. If we inhale this poisoned air, or drink this tainted water, and our bodies are not in good order, typhoid-fever is the result. Its symptoms

Questions. — Describe another form of this disease. What can you say about typhoid fever? Explain how it may get into the system.

are a constant fever, great prostration, profuse sweating, delirium, headache, and other bad symptoms, which often lead to a fatal result.

This disease does not pass from one person to another, — that is, it is not contagious; neither does it come of itself from decaying animal matter. The poison must come from the sick person, and must first infect or poison matter in a condition of decay. This matter so poisoned enters our drinking-water, or arises in a state of vapor from bad drainage and sewers, and is drawn into the mouth and swallowed.

141. **Protection against Fevers.** — All low, moist countries are greatly subject to malarial and typhoid fevers. Formerly malarial fevers were most prevalent on the eastern shore and the lower counties of our State, — St. Mary's and Charles. The marshy grounds, rivers, and inlets of the Chesapeake Bay formed an extensive and fertile soil for this disease. Of late years these fevers have invaded the western shore of Maryland, even up to the high lands of the Blue Ridge Mountains.

Children are peculiarly susceptible to intermittent and remittent fevers, and, to a less degree, to typhoid-fever. In many parts of our State, there appears just enough of the malarial poison to affect them,

Questions. — What kind of countries are most subject to malaria?

while grown persons escape. This is an important truth not generally known. It is well for young people to recognize its importance.

Much can be done to avoid these fevers. Cleanliness of person, a careful diet, avoidance of late out-door hours, and sleeping in over-crowded and badly ventilated rooms, should be rigidly observed. Clean cellars, open drains, and properly built and cleanly kept sewers, tend to ward off disease. All bad-smelling places should be freely sprinkled with chloride of lime. Schoolrooms should be well ventilated, and too many pupils should not be crowded into one room. Too much study or too much play weakens the body, and renders it a fit soil for the growth of these dreaded diseases.

Question. — What may be done to avoid these fevers?

GLOSSARY.

Ab-do′men. See Sect. 6.

Ab-sorp′tion. The process of sucking up nutritive or waste matters by the blood-vessels.

A′cid. A substance usually sour, sharp, or biting to the taste.

Ad′am's Ap′ple. An angular projection of cartilage in the front of the neck. It is prominent in males.

Al-bu′men. An animal substance resembling the white of an egg.

A-nat′o-my. See Sect. 5.

A-or′ta. The largest artery of the body.

A′que-ous Humor. The watery fluid occupying the space between the cornea and crystalline lens of the eye.

Ar′te-ry. A vessel by which blood is carried from the heart.

Au′di-to-ry Nerve. The special nerve of hearing.

Au′ri-cle. A cavity of the heart.

Bile. The gall; a secretion of the liver.

Bronch′i. The first two branches of the windpipe.

Bronch′i-al Tubes. The smaller branches of the windpipe.

Bun′ion. An enlargement and inflammation at the first joint of the great toe.

Ca-nal′. In the body, any tube or passage.

Cap′il-la-ry. The "hair-like" blood-vessels.

Car-bon′ic A′cid. The gas which is breathed out from the lungs; a waste product of the animal kingdom, and a food of the vegetable kingdom.

Car′di-ac. The orifice of the stomach, near the heart.

Car′ron Oil. A mixture of equal parts of linseed-oil and lime-water.

Car′ti-lage. A tough but flexible material, forming a part of the joints, nostrils, ears; gristle.

Ca′se-ine. The albumen part of milk; forming the basis of cheese.

Cer-e-bel′lum. The little brain.

Cer′e-brum. The brain proper.

Chlo′ral. A powerful drug used by physicians to induce sleep.

Cir-cu-la′tion. The course of the blood through the blood-vessels of the body.

Co-ag-u-la′tion. Applied to the

process by which the blood clots or becomes solid.

Con-ges′tion. An unnatural gathering of blood in any part of the body.

Con-sti-pa′tion. Costiveness; tardiness in evacuating the bowels.

Con-vul′sion. A more or less violent agitation of the limbs or body; a fit.

Corn. A portion of the outer skin, of horn-like hardness.

Cor′ne-a. The transparent substance which covers a part of the front of the eyeball.

Cor′pus-cles, Blood. The small bodies which give to the blood its red color.

Crys′tal-line Lens. A double-convex body situated in the front part of the eyeball.

Cu′ti-cle. The scarf-skin; also called the *epider′mis.*

Cu′tis. The true skin, lying beneath the cuticle; also called the *der′mis.*

De-lir′i-um. A state in which the ideas of a person are wild, irregular, and unconnected.

Di′a-phragm. See Sect. 6.

Di-ar-rhœ′a. Unnaturally frequent and liquid evacuations of the bowels.

Dis-in-fect′ants. Agents used to destroy the causes of infection.

Duct. A canal or tube.

Dys-pep′si-a. Indigestion.

El′e-ment. One of the simplest parts of which any thing consists.

E-met′ic. A medicine which causes vomiting.

E-mul′sion. Oil in a finely divided state, suspended in water.

En-am′el. The dense material which covers the crown of a tooth.

Ep-i-glot′tis. See Sect. 41.

Ex-cre′tion. The separation from the blood of the waste matters of the body.

Ex-pi-ra′tion. The act of forcing air out of the lungs.

Ex-ten′sion. The act of restoring a limb, etc., to its natural position after it has been flexed.

Fi′bre. One of the tiny threads of which many parts of the body are composed.

Fi′brine. A substance like albumen, found in the blood.

Flex′ion. The act of bending a limb.

Func′tion. The special duty of any organ of the body.

Gas′tric. Pertaining to the stomach.

Gel′a-tine. An animal substance which dissolves in hot water, and forms a jelly on cooling.

Germ. A living particle detached from already existing living matter.

Gland. See Sect. 5.

Glu′ten. The albumen-like part of wheat.

Gym-nas′tics. The practice of athletic exercises.

Hy′gi-ene. See Sect. 5.

In-spi-ra′tion. The act of drawing in the breath.

In-tes'tines. The bowels.

I'ris. The thin curtain between the cornea and crystalline lens, giving the eye its color.

Lac'te-als. The absorbent vessels of the small intestines.

Lig'a-ment. A strong, fibrous material, binding bones or other parts together.

Mar'row. The soft, fatty substance contained in bones.

Mas-ti-ca'tion. Chewing.

Mi'cro-scope. An optical instrument which assists in the examination of minute objects.

Mu'cous Mem'brane. The thin layer of tissue which covers those parts which communicate with the external air.

Mu'cus. The glairy fluid which is secreted by mucous membranes, serving to keep them in a moist condition.

Nar-cot'ic. A medicine which in poisonous doses produces stupor, convulsions, and sometimes death.

Na'sal. Pertaining to the nose.

Nic'o-tine. The poisonous oil extracted from tobacco.

Nos'trils. The two outer openings of the nose.

Nu-tri'tion. The processes by which the nourishment of the body is accomplished.

Ol-fac'to-ry. Pertaining to the sense of smell.

Op'tic. Pertaining to the sense of sight.

Or'bit. The bony socket in which the eyeball is situated.

Or'gan. A portion of the body having some special duty.

Pal-pi-ta'tion. A violent and irregular beating of the heart.

Pa-pil'la. The name of the small elevations found on the skin and mucous membranes.

Par-al'y-sis. Loss of motion or feeling; palsy.

Pep'sin. The active principle of the gastric juice.

Per-spi-ra'tion. The sweat.

Pha-lan'ges. The bones of the fingers and toes.

Phys-i-ol'o-gy. See Sect. 5.

Plas'ma. The liquid part of the blood.

Poi'son. Any substance which, when applied externally, or taken into the stomach or the blood, produces disease or death.

Pul'mo-na-ry. Pertaining to the lungs.

Pulse. See Sect. 60.

Pu-pil. The opening in the iris through which light passes into the eye.

Py-lo'rus. The outlet from the stomach into the small intestines.

Re'flex. The name given to certain involuntary movements.

Res-pi-ra'tion. Breathing.

Ret'i-na. The innermost of the coats of the eyeball, being an expansion of the optic nerve.

Sa-li'va. The spittle.

Se-cre'tion. The process of separating from the blood some essential fluid, which is also called a secretion.

Sen-sa'tion. The perception of an external impression by the nervous system.

Se'rum. The clear, watery fluid which separates from the clot of the blood.

Sock'et. An opening into which any thing is fitted.

Spasm. A sudden, violent, and involuntary contraction of one or more muscles.

Spe'cial Sense. A sense by which we receive particular sensations, such as those of sight, hearing, taste, and smell.

Sprain. An injury to the ligaments or tendons about a joint.

Stim'u-lant. An agent which causes an increase of vital activity in the body or any of its parts.

Sut'ure. The union of certain bones of the skull by the interlocking of jagged edges.

Ten'don. The white, fibrous cord by which a muscle is attached to a bone; a sinew.

Tho'rax. The chest.

Tis'sue. See Sect. 5.

To-bac'co. A plant used for smoking and chewing, and in snuff.

Tra'che-a. The windpipe.

Vein. A vessel by which blood is carried to the heart.

Ven-ti-la'tion. The introduction of fresh air into a room or building in such a manner as to keep pure the air within it.

Ven'tri-cles of the Heart. The two largest cavities of the heart.

Ver'te-bra. One of the bones which make the backbone.

Ver'te-bral Col'umn. The backbone; also called the spinal column, and spine.

Vil'li. Minute thread-like projections found upon the inner surface of the small intestine, giving it an appearance like plush.

Vit're-ous. Having the appearance of glass; applied to a fluid in the cavity of the eyeball.

Vo'cal Cords. Two elastic bands in the windpipe; the essential parts of the organ of voice.

INDEX.